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THE

COMMENTARIES

UPON THE

APHORISMS

OF

Dr. HERMAN BOERHAAVE,

The late Learned Professor of Physick in the
Univerfity of LEYDEN,

CONCERNING

The KNOWLEDGE and CURE of the feveral
DISEASES incident to HUMAN BODIES.

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Translated into ENGLISH.

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SECOND VOLUME.

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COM M E N T A R I E S

U P O N T H E

A P H O R I S M S

O F

HERMAN BOËRHAAVE,

C O N C E R N I N G T H E

K N O W L E D G E a n d C U R E o f D I S E A S E S .

O f W O U N D S i n g e n e r a l .

IT may perhaps seem surprizing to some, that the celebrated author of these aphorisms, should have descended to so careful and minute a consideration of the external disorders which belong to surgery; more especially as the common and prevailing opinion is, that the Physician's province comprehends the injuries which make the proper business of a Surgeon. But it is certain, that the branch of physic which regards external maladies is the most ancient of any. Herein Podalirius and Mechaon, two sons of Æsculapius, were highly serviceable to the soldiers in the Trojan war under Agamemnon; but these are mentioned by Homer, as not assisting in the pestilence or other internal maladies, but in wounds only, which they cured by the hands, instruments, and medicines.

But physick was afterwards divided into three parts; one for curing by diet, the other by medicine, and the third by the use of the hands. But yet Surgery was not neglected by Physicians. For the very parent of physick, Hippocrates, has wrote beautifully on wounds of the head, on ulcers, fistulæ, fractures, luxations, &c. nor has he slightly considered those accidents and injuries, but he has also described at large the methods and machines to be used for the cure of fractures and luxations. To this we may add, that it is of the highest use towards the cure of internal diseases, to examine and compare the maladies which are seated externally. These last are all of them more obvious to the senses, and more easily understood. Thus we can much more evidently understand external inflammations, and their various ways of terminating, than those seated internally. What light do we not receive into the nature of obscure diseases in the head, from a previous knowledge of the wounds in that part. Since therefore the general and best method of learning, is to pass from the easier to the more difficult propositions, therefore those external disorders which belong to surgery, are here deservedly transposed before the history of internal and more obscure diseases.

S E C T. CXLV.

A Wound is a recent and bloody solution of the continuity in any soft part, by the motion, pressure or resistance of some hard or sharp body.

We are here furnished with an accurate definition of a wound, *viz.* that it is a solution of continuity in the soft parts; but then the term recent must be added, in order to determinate a wound, and to distinguish it from an ulcer, which is also accompanied with a solution of the continuum: but in Hippocrates (*de vulnerib. Capit. c. 12.*) ἰλκὸς καὶ τραῦμα, both the term wound and

Sect. 146, 147. Of WOUNDS in general. 3

and ulcer are used promiscuously for each other, even in one and the same chapter. A wound is also here defined a *bloody* solution of continuity, for else, if the wound be so small as not to discharge any red blood, it is not worth notice, since even the point of the smallest needle cannot enter the skin of one's fingers end, without being followed with the blood. It is again said to be a solution of the continuity in some *soft part*, to distinguish it from fractures or fissures, which are the like solution in bones or hard parts. Lastly to distinguish the wound from contusions, is added from some hard and *sharp* body or instrument, which communicates or impresses the motion of its parts by a small surface: but then no hard or sharp body can separate the cohesion or continuity of a part, without it be forced by motion or pressure, or without the soft parts are moved or pressed against the sharp and resisting body. Every person will readily conceive the same effect to follow, whether the arm be thrust against the lancet, or the lancet against the arm.

S E C T. CXLVI.

TH E sensible cause therefore of a wound, is the hardness, sharpness, and motion, or resistance, of the wounding instrument.

This aphorism is self-evident; for if the instrument was not hard, it could not overcome the cohesion of the parts; and if it was not sharp, it would make a contusion instead of a wound.

S E C T. CXLVII.

TH E subject of a wound then is any soft part, which must be therefore a compages or intertexture of vessels, sanguiferous, serous, lymphatic, and adipose; nervous, membranous, tendinous; with the receptacles composed of these.

It is evident from the definition of a wound, that its subject must be some soft part; and anatomical dissections daily demonstrate, that the soft parts of the body are mere compages of vessels; so that no wound can be inflicted, without dividing a great number of vessels of the several different orders or classes enumerated. There is not any sanguiferous artery can be divided, without injuring several vessels of the smaller or decreasing series; for the coats of the first vessel are composed of smaller vessels, and the coats of these latter, still of smaller vessels, 'till we come to the very last or smallest. Hence we see that in the most simple wound the sanguiferous arteries are divided, together with the ferous and lymphatic, &c those cells are also wounded, which discharge a mucus to lubricate the internal sides of the arteries, which appears to the eye in the larger trunks; the membranes also are divided with the muscular fibres composing the muscular coat of the arteries, &c. It is therefore evident, that all the parts enumerated in this aphorism are injured in the slightest wound.

S E C T. CXLVIII.

IN these parts (147), the cause (146) produces a division of the continuity or cohesion, and an extravasation of their contained juices.

As no solution of continuity can be effected in a soft part without injuring a great number of vessels, it is thence evident, that every wound must be always attended with two consequences: first by a separation of the vessels and fibres, and then an extravasation as well of their contained juices, as of those continually brought into them by the circulation. Since therefore it is evident, from the preceding paragraph, (*ad* §. 147.) that all the series of vessels may be injured in a wound, it is also as apparent, that all the kinds of their contained

Sect. 149, 150. Of WOUNDS in general. 5
tained juices or humours may be extravasated from the
wounded vessels.

S E C T. CXLIX.

FROM thence the actions resulting from the
continuity and regular circulation of the
juices through the vessels, are either injured or
abolished.

The whole body we know to be composed of solids
and fluids; nor can any wound be conceived without
destroying the continuity of the solid parts, and in-
terrupting the circulation of the juices through the
vessels wounded, which were before entire. But all
the actions of our bodies depend on the sound state of
the solids, with the regular motion of the fluids thro'
the vessels; whence it follows, that no wound can be
inflicted without injuring some of the functions at
least. Thus, for example, to bend the fingers at plea-
sure, it is required that the profundus and sublimus
muscles destined to that office be entire; but if the
tendons of those muscles are wounded or divided, the
actions resulting from them must perish.

In our professor's institutes it is demonstrated, that
among other necessities towards the action of a mus-
cle, it requires a free influx of spirits by the nerves;
but if the nerves detached to any muscle are divided
by a wound, the determinate flux of nervous juice in-
to the muscle will be destroyed, and consequently its
action abolished.

S E C T. CL.

SUCH wounds therefore as are inflicted in
parts, whose continuity is absolutely neces-
sary to or inseparable from life, are mortal.

A mortal wound is one whose inevitable consequence

is death; but death follows when the course of the blood into the heart, and its expulsion from thence is impeded: for to continue the action of that muscle in receiving and expelling the blood, it is required that many other parts remain sound and entire. Every wound therefore which destroys what is absolutely necessary for the blood's free course to and from the heart, is really in its own nature mortal. But the nature and seat of such mortal wounds we shall consider hereafter.

S E C T. CLI.

BUT of these wounds (150), some are absolutely and inevitably mortal.

Such wounds as are followed with death as the consequence, all agree in this, that they destroy the reception and expulsion of the blood into and from the heart; but then there is a great difference among them in other respects: for some of them are inevitably in their own nature mortal, and that notwithstanding the Surgeon may be well acquainted with the nature and seat of the parts wounded, which not being capable of any relief from art, death must be the inevitable effect or consequence of the wound as a cause. *E. g.* if a wound be made in the thorax by a two edged sword, so as to penetrate the aorta where it passes out of the pericardium; in that case all the blood expelled by the left ventricle of the heart, will be discharged through the wound of the vessel, and escape either into the cavity of the thorax, or be lost through the external wound; hence blood will not return to the right ventricle of the heart again by the veins, so that inevitable death follows, which can be prevented by no art whatever: for neither is the part wounded accessible, to make a ligature, future, &c. nor, if that was practicable, could the heart discharge its blood into the tied aorta, whence the circulation would be stopped, and life destroyed.

But

But if one of the crural arteries be wounded as it passes into the thigh, such a wound will be in itself mortal, because the whole mass of blood will escape from the wounded artery; but yet it is not absolutely or inevitably mortal, because the artery above may be so compressed by ligature or the tourniquet, that no blood will escape through it, and afterwards it may be tied up, &c.

These distinctions are of such importance, that they ought to be strictly regarded by Surgeons and Physicians in making their reports of wounds to the judges.

S E C T. CLII.

AND other wounds prove mortal by being left to themselves, but yet might they be remedied by art, so as to prevent the danger of death.

All the larger arteries distributed through the limbs, make the patient bleed to death when they are wounded; and therefore a wound in such an artery is really mortal, but yet remediable by art, so as to prevent the consequent fatality. Such instances we have many in the writers of observations. A student wounded one of the public watchmen with his sword, in such a manner, that the artery, which is deeply seated under the muscles of the calf of the leg, was divided, inso-much that the person wounded fell with the loss of blood, and was taken up almost dead: the people reviving him with cordials, a fresh hæmorrhage ensued 'till he fainted: the ignorant Surgeon then filled the orifice of the wound with styptic powders, and in the mean time endeavoured to recruit the languishing patient with more wine and cordials, so that by increasing the motion of the blood, the patient bleeds to death notwithstanding his styptics. This wound was reported mortal. It is true, this wound was the cause of the person's death; but yet might he have

been preserved by art, or a more skilful treatment: for had the Surgeon compressed the artery in the ham by the tourniquet, or a ligature, the hæmorrhage would have ceased; or, at worst, the wound might have been dilated, and the artery tied up, or else his life might have been preserved by amputating the part.

A like case also happened in a duel, from a wound of the bronchial artery, where it is deeply seated upon the transverse ligament which lies betwixt the radius and ulna; and in this case the artery might have been compressed in the upper part of the arm where it runs almost naked upon the bone of the humerus: thus might the hæmorrhage have been restrained and the limb afterwards amputated so as to preserve the life of the person wounded. But neither would the patient admit of so severe an operation, nor did the Surgeon urge the necessity of it, thinking that the compressure being made strong, would suffice to restrain the hæmorrhage; insomuch that the patient, who might have been preserved by amputation, was destroyed by a mortification of the limb, induced by the great stricture or compressure.

Hence it is evident, how necessary it is for those Surgeons and Physicians, who treat wounds and make reports of them to the court of judicature, to be well acquainted with the course of the larger blood vessels, and to know in what places they may be most easily compressed to prevent a fatal hæmorrhage. This course of the vessels is most exactly represented in the tables of Eustachius.

S E C T. CLIII.

LASTLY, wounds not mortal in themselves, may become so either by neglect or error.

This aphorism is generally too true in those who are the least regarded, or in those who are wounded in battle; how many of these perish from loss of blood,
who

who might have been saved by a skilful Surgeon? what numbers are lost from blood extravasated under the cranium, who might have been preserved by a timely application of the trepan? The external integuments of the cranium being injured by a violent contusion, with a small wound or aperture at the same time, has only by neglects often induced the most fatal symptoms and even death itself, all which might have been frequently prevented by a proper method of treatment. We meet with innumerable instances of this nature among the writers of observations.

But wounds may be rendered mortal not only by the Surgeon's neglecting to do what is required by his art, but also by his errors, or doing what ought to be let alone. Persons seldom die from the loss of blood in a wound, unless some very large artery be divided; but after a considerable hæmorrhage, they generally faint, and the blood stops: if now they are left in a place moderately warm for a considerable time in that manner half dead, and if then they are only supplied with flesh broths given frequently and in small quantities, life will be preserved in that languid state, that the divided vessel contracts and often closes of itself: thus have many been preserved who must otherwise have inevitably perished. But when the patient faints in a profuse hæmorrhage, and they endeavour to recover him by cordials and spirituous medicines, instead of repairing the lost juices, the action of the heart and arteries is so increased, that a fresh hæmorrhage ensues and continues even 'till death. Many have been left as dead for whole days among those slain in battle, and yet have they afterwards recovered tho' almost exhausted of blood.

Some Chemists recommend arsenic fixed with nitre as a capital remedy to stop hæmorrhages; but the danger of applying so virulent a poison to a naked wound will be quickly manifest; since the taking of the least particle of the same poison may excite the most cruel convulsions, and even death itself.

Hence

Hence therefore, when wounded bodies are examined by publick authority, the first enquiry ought to be whether the wound was inevitably in itself mortal, or whether the patient might have been preserved by any artifice as yet known; or, lastly, whether the patient's death ought to be ascribed to the wound or to other causes.

It is not therefore altogether sufficient to inspect the wound only, to judge of its morality, but a strict enquiry must be also made into every particular that has happened to the patient since the first infliction of the wound.

S E C T. CLIV.

BE S I D E S death, there are also many other consequences or effects of wounds, which are variously denominated, according to the different actions of the entire parts before they were wounded: and these are readily understood by one acquainted with the actions of parts in health.

There may be as many different effects or distinct actions injured from a wound as there are different parts of the body, whose actions result from the continuity of those parts. But one who is acquainted from anatomy and physiology with the uses of the parts, as far as they are at present known, he will determine the consequences or effects of the wound as soon as the parts affected are known. If the tendon of a muscle is divided, it is evident the action of the muscle will cease, as it depends upon the continuity of the tendon, &c. A maid-servant fell down with a glass mug in her hand, and some fragments of the glass made a deep wound in the part betwixt the carpus and the cubitus, a profuse hæmorrhage also followed from a division of the artery running under the *flexor carpi-ulnaris*

ulnaris muscle: the hæmorrhage was happily restrained, by compressing the trunk of the artery against the *os humerus* in the upper part of the arm; but then the maid complained of a numbness in her little finger, and in the middle of the next finger, which the Surgeon judged to arise from the compressure of the artery; but being confirmed in my opinion by the accurate tables of Eustachius, I boldly affirmed that the nerve was divided which goes to the little finger, and to the middle of the next adjacent finger, and that therefore this complaint was irremediable. The event demonstrated the truth of my assertion: for after the cure was compleated, at my request, she frequently put her finger into the flame of a candle without perceiving any pain.

Hence therefore it is evident, the effects of wounds will be various, according to the different nature and actions of the parts wounded.

S E C T. CLV.

NOR is there less difference in the names, figures, and effects of wounds, according to the different cause or instrument (146) inflicting them, and according as the instrument is differently shaped and applied, either in pricking or stabbing, cutting, contusing, straggling, or lacerating, &c. with the force of intruding and extracting, or its remaining wholly or in part in the wound, the infection or poison it leaves behind, &c.

In this aphorism is considered the diversity of wounds, as arising from the difference of the wounding instrument.

Differently shaped or applied.] If the wounding instrument was conical or sharp pointed, the wound is then a puncture which readily closes itself; and then it becomes difficult to know the depth of the wound;

wound; but if the instrument was formed like a sharp wedge, the wound will be a cut, &c. The method of applying the instrument also makes a great difference; for by pricking or stabbing is formed a narrow wound, which yet often penetrates very deep. By cutting or drawing a sharp wedge over soft parts, wounds are made long, but generally shallow or superficial.

Contusing or beating.] In this case the instrument is generally applied with a force greater than usual, and it penetrates deeper; so that if it be not exceeding sharp, it also makes a contusion with the wound.

Straggling or lacerating, &c.] This is a circumstance that ought to be closely attended; for when a wound is inflicted by a sword in the arm extended, the weapon often penetrates directly in a right line; but when it runs unequally, or when the sword is agitated and turned about in the wound, it does infinitely more mischief, and wounds or lacerates more parts. But this may be in a great measure known from the appearance of the wound: for if the orifice of the wound is of the same size with the instrument, the latter was then thrust straight forward in the wound; but if a broad sword makes a round orifice, it is a sign the weapon was turned round in the wound.

Force of intruding and extracting.] Thus the wound will be more or less deep in proportion, as the instrument was intruded with a greater or less force. But in some wounds the instrument is often better left a while in the parts than immediately extracted: as when the instrument compresses a wounded vessel, and so restrains a hæmorrhage, which upon extracting the instrument, has proved so great as to destroy the patient, or if the instrument is bearded like a hook, &c.

The infection or poison left behind.] In this respect we are convinced by many surprizing experiments and observations, that there are many poisons in nature which may be swallowed without injury, but upon
applying

applying them to a naked wound, they cause certain and sudden death. Thus it is with the viperine poison, which infused into the wounds made by their teeth, produces certain death in pigeons, poultry, man, and even larger animals. When the learned were ordered by the Grand Duke of Tuscany to enquire into the nature of the viperine venom, some of them asserted it lay in the gall of that animal, confirming their opinion by the authority of the Ancients, and the testimony of many Moderns; but a viper-catcher standing in a corner of the room, being more bold than the ancient Marfi and Pfylli, courageously drank off the bile of a viper in half a glass of cold water, without any bad effect following. Nor did the viperine bile cause any detriment to the brute animals to which it was given; nor did it any injury to the naked wounds to which it was applied.

Others of them thought it the most probable opinion, that the viperine venom was lodged in those cells near the teeth; for that in those cavities was contained a juice, in colour and taste very much like oil of almonds: and the viper could not bite without compressing those cells in its jaws, so as to force the juice into the wound: but though this virulent juice produced such fatal effects, by penetrating the wounds made by the teeth of the viper; yet he who before drank off the bile, was courageous enough to drink this, together with the froth and saliva expressed from the jaws of an enraged viper, which being swallowed in a glass of wine had no bad effects. And it was likewise swallowed by brutes with the like success.

Those poisonous darts from Bantham, which certainly kill by making a slight wound, being infused in wine, or any other liquor for several days, do not communicate any virulency to the liquor in which they have lain so long.

When Cato conducted the army through the burning deserts of Lybia, the thirsty soldiers dared not to drink of the water of a spring which abounded with serpents,

14 Of WOUNDS in general. Sect. 156.
serpents, but the wise general advised them to drink
boldly,

*Vana species conterritæ lethi
Ne dubita miles tutos haurire liquores.
Noxia serpentum est admisto sanguine pestis.
Morfus virus habent, & fatum dente minantur.
Pocula morte carent. Dixit, dubiumque venenum.
Hausit & in toto Libyes fons unus arena
Illa fuit, de quo primus sibi posceret undam.*

Lucan. Pharsal. lib. 9.

When a thread that has been dipt in oil of tobacco is drawn through a wound made by a needle in any living animal, it quickly expires. S. Redi thus killed a viper in less than half a quarter of an hour: but yet he could not observe, that in all the species of tobacco, the oil had the same degree of strength or malignity.

There are many more such in nature, which lie perhaps better concealed than exposed. When therefore we observe any unusual symptoms in a wound, which we cannot reasonably think to arise from the parts wounded, there is then reason to suspect the instrument was poisoned or infected.

S E C T. CLVI.

ALL these (155) again vary according to the difference of the parts wounded, as they are either hard, soft, connected, situated, shaped or affected, and replenished with various juices (147).

In the two preceding aphorisms we are furnished with the difference of wounds, as arising from the different actions of the parts injured, and the various causes or instruments inflicting the wound: but in this section we consider the difference of wounds arising from the different nature of the wounded parts.

Hard

Hard or soft.] Thus an instrument will require but a small force to make it penetrate through the integuments of the abdomen? but it will require a much greater to divide the hard bones of the skull.

Connected.] When the tendon of a muscle is divided, the motion of the part to which it belongs is consequently destroyed, and may therefore be judged an effect of the wound. When a small artery belonging to a tooth lately extracted bleeds incessantly, so as almost to destroy the patient, so considerable an hæmorrhage does not arise because the small artery is wounded, but because the said artery is connected to the boney socket of the tooth, so that it cannot contract or close itself. When the aponeurosis arising from the tendon of the biceps muscle in the arm is accidentally injured in opening a vein, the severe symptoms which follow, do not result from the slight wound or puncture in the part, but from its tensity and connection with adjacent parts.

Situated.] If a small branch of one of the intercostal arteries is wounded, so that the pleura is perforated at the same time, the extravasated blood will then escape into the cavity of the thorax, where corrupting it may inflame the lungs, and cause a suppuration thereof, terminating in a fatal consumption; and all this because the wounded artery is so situated, that its blood may be extravasated into the cavity of the thorax. For in other parts of the body, an artery much larger may be divided without any danger. Thus also a wound is much more dangerous when inflicted in the interior than in the exterior part of the thigh, because of the great blood vessels which are seated in the former.

Affected.] Such is the disposition of many parts in the body, that when wounded or otherwise injured they disturb the actions of other parts, when at the same time we are furnished with no reasons from anatomy for such a communication of the disturbance to the other parts. For example, after severe pains of
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the cholic and iliac passion, particularly in that species termed *colica pictonum*, a palsy of the arm follows, and by a continuance of the pains, the upper limbs are consumed with a true marasmus. But who can pretend to explain the reason of such an extent from the structure of the parts? When some of the mesenteric nerves have been divided in wounds of the abdomen, excruciating pains follow soon after, and in a little time even death itself, though at the same time none of the large vessels or viscera appeared injured upon opening the body. After dividing the intercostal nerve with the eighth pair in a dog, in which animal they are included together in one capsule or vagina, the eye of the same side has appeared dim or obscure, has fallen away and become inflamed; and always by this experiment the eyes have been found very sensibly changed and considerably injured. But this is not explicable from the known structure of the parts, but we are only assured of the effect by observation (a) made after wounds. Hence it is evident, that another great variety or difference in wounds will arise from the consequences following in other parts, and that we know many of those effects from observation only, since they cannot be demonstrated from any reasoning (*à priori*) from the causes.

Shaped.] For different parts of the body may be more or less deformed by wounds, so as to make them deviate greatly from their original conformation: and thus may the external shape of the face be surprizingly altered. When the muscles in one side of the face are paralytic, what a strange distortion is there of the other side of the face, because the muscles draw the sound side awry, for want of the action of the antagonist muscles. It is also sufficiently evident, that the like effects will follow from wounds, when only some of the muscles of the face are divided, or when only the nerves are cut which lead to those muscles.

(a) Mem. Acad. l'an. 1727. pag. 6, & seq.

S E C T. CLVII.

BUT though it is necessary for one to be acquainted with the origin or causes of this multiplicity or difference in wounds, yet will it be neither necessary nor useful to dwell upon a subtle distinction of them by names.

Every one must allow that it is necessary for such Surgeons and Physicians as are concerned in wounds, to attend closely to what has been said in the three preceding aphorisms; since from thence follow the diagnosis and prognosis of wounds, founded upon the certain basis of the structure and action of the parts. After the wounding instrument with the force and manner of its application are known, the next consideration ought to be in the nature of the parts wounded, that by a previous acquaintance with their actions and uses, we may foretel what consequences are to be feared, and understand what lies within the power of art to effect, towards the cure of the present disorder, and the prevention of future accidents. But it would be a difficult task to impose distinct names on every different wound, as depending on such a variety of circumstances, and it would be still more difficult for any one to remember them. It is true, Amb. Parey has thus formed a table of the difference of wounds, which he has prefixed to his treatise on that subject; but whoever considers the thing, will find it of little or no service. It is sufficient to have a general knowledge of the principles from whence such a great diversity in wounds arise.

S E C T. CLVIII.

IF a wound be inflicted on a strong and healthy body, in a visible part that is neither very ten-
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dinous nor furnished with any large artery, it will be attended with the following appearances, provided the mouth of the wound be preserved from drying, and defended from the air and cold.

In order to say any thing certain on the cure of wounds, it is necessary to premise the symptoms or appearances which our senses and a faithful observation have remarked in them, from their first infliction 'till their consolidation or cure. By remarking all these in the natural order in which they arise, we arrive at the knowledge of the certain method used by nature, to restore the divided parts to their pristine cohesion or union.

But to avoid all error and confusion, we shall here consider the wound only, and presuppose the person wounded to be perfectly in health; otherwise the appearances to be observed will arise not only from the wound, but also from the concomitant disorders or ill habit of body. Very different will be the appearances of a wound, when the patient is cacochymical, or afflicted with the scurvy, pox, rickets, &c. We shall also suppose the person of a robust habit; for in weak people the circulation is so languid, that the blood does not flow to the wound with any considerable impetus, whence the pain, heat, tension, &c. of the parts will be much less than in the lips of a wound inflicted on a strong man.

We are also to observe all the appearances as they come under our senses, and therefore the wound must be in some external part of the body. for the same reason too we must suppose the part wounded to be without any considerable artery; for if so considerable a vessel were divided, the blood would run like a fountain by starts, and obscure the whole.

Add to this, that the wound must not be in a part very tendinous; for if the tendon of any muscle be wounded and not totally divided, the contraction of
the

the muscle belonging to the tendon will continually distract or lacerate the rest, and excite a train of horrid symptoms, arising not from the wound, but the contraction of the muscle belonging to the injured tendon. The description therefore of the disorders arising from wounds of the arteries and tendons, are to be postponed and considered afterwards.

Lastly, if the cold air be admitted to a wound, it injures and dries up the tender vessels, and perverts the natural state of the wounded parts. Thus if the cranium was laid bare by a wound, and the air freely admitted to it for any considerable time, such a wound would hardly admit of a cure before the exposed bone exfoliated or cast off its exterior lamella. But this circumstance of exfoliation is independent of the wound, which if it had been secured from the air, no such thing would have happened.

The phænomena or symptoms common to all wounds are therefore supposed under these conditions, and stated in the following numbers.

1. The parts between which the wounding instrument was forced, do gradually separate more and more from each other, even though the said instrument be removed, unless the wound be a small puncture.

So soon as the wounding instrument has divided the continuity of the parts, the distance betwixt the lips of the wound is then equal to the thickness of the instrument, and therefore when the executioner cuts or marks the malefactors in the face with a sharp razor, the first appearance is only a red line, but then the lips of the wound immediately begin to recede gradually from each other, and in a few hours time they are several lines distant one from the other. For the force by which the parts of our bodies cohere together continuing to act, the lips of the wound are therefore dilated or drawn back from each other,

because that cohesion is destroyed in the place of the wound.

Unless the wound be a small puncture.] For when an acuminated instrument makes only a small puncture, penetrating through the skin, and wounding the subjacent cellular membrane, if the person be not very lean there appears no wound, because the soft fat or cellular membrane is by the contraction of the skin forced directly up into the wound so as to occlude its orifice. For the same reason, when a vein is opened in a fat person, the stream of the blood is often suddenly interrupted by the intrusion of the fat into the orifice of the wound, by the contractile force of the skin.

2. The blood next runs out of the wound, first impetuously, and then gradually slower, 'till it stops of its own accord.

If no considerable artery is wounded, nor one that adheres to any bone, so as to be incapable of contracting, in that case the blood will issue impetuously from the wound at first, but soon after the divided vessels, contracting by their elasticity, will close their own orifices, and conceal themselves within the lips of the wound, by which means the hæmorrhage soon diminishes, and at length wholly ceases. That this is the case is very apparent in cutting for the stone, for in that operation the skin and subjacent parts are divided by a large incision, whereupon an ounce or two of blood soon follows, but then the hæmorrhage quickly after ceases almost entirely, if no considerable artery is unluckily divided; otherwise the hæmorrhage would very much disturb the operation. All the blood running from a wound comes almost entirely from the divided arteries; since veins, even considerably large ones, afford little or no blood, unless some stricture or resistance be made on them, betwixt the wound and the heart: but even arteries themselves readily contract

tract by their elasticity, so as quickly to restrain the hæmorrhage.

3. Soon after, the blood is incrustated over the surface or cavity of the wound.

Since little more than the arterial blood flows from a wound, in the manner before specified; and since that blood from a strong and healthy person soon coagulates after extravasation, therefore when the impetus of the hæmorrhage ceases, the blood forms a little thrombus, coagulum or bloody crust, which serves to agglutinate the lips of the wound, and covers its whole surface so closely, as to make a natural and secure defence to the tender parts of the wound, under which the divided fibres and vessels gradually unite and close 'till the wound is perfectly consolidated or healed. As this crust continually hardens and dries by the air and heat of the body, it at last forms a hard stopper to the mouth of the wound, which being healed it separates and falls off of its own accord.

4. Next, the wound discharges a thin, dilute, and reddish-coloured liquor.

While the forementioned crust is forming, or if it be taken off, the wound does not discharge blood, but a much thinner juice of a dilute red colour, somewhat resembling the washings of flesh taken from animals lately killed. But this appearance seems to arise from the blood-vessels contracting themselves so much, as to prevent the cruor from escaping, while their divided orifices transmit a larger quantity of a thin and red-coloured serum.

5. The lips of the wound then begin to turn back, look red, and become hot, tumid and painful, the divided parts producing themselves out-ward,

ward especially the *membrana adiposa*, which soon degenerates.

When the divided vessels contract their orifices by their own elasticity, the hæmorrhage and serous discharge soon stop, and those juices being still urged on by the circulation towards the lips of the wound, and there meeting with obstruction, the vessels will be distended before the obstructed parts, and a true inflammation is thence produced. Thence the lips of the wound look red on the second or third day after, and are then attended with greater heat, inflammation, and tumour; all which, when moderate, are no bad presage, since they happen naturally in all wounds. Hence appears the reason why recent wounds are scarce at all painful; but when the parts are inflamed and swelled on the second or third day, there is then a considerable pain felt in the wound.

On this account Hippocrates (*a*) says, *gravibus vulneribus inflēctis si tumores non appareant, ingens malum*: “that when the lips of the great wounds do not inflame or swell, it is a very bad presage.” The same he also repeats in his aphorisms (*b*), where he adds, *molles tumores boni, crudi pravi sunt*: “that a soft tumour of them is good, but a crudity or induration bad.” For if no tumour arises about the wounded parts, it denotes the wounded parts to be languid; but if the tumour is too great, there is danger of a worse consequence from the intense inflammation.

Hippocrates (*c*) likewise justly inculcates, *Tertia & quarta die minime vexanda sint vulnera, & ab omni exploratione per specillum tunc sit abstinendum, & ab omnibus aliis quibus vulnera irritantur. In totum enim pleræque vulnera tertio aut quarto die recrudesce consueverunt*. “That wounds ought not in the least to be disturbed on the third or fourth day, at which time
“ all

(*a*) Epidem. Lib. II, Charter. Tom. IX. pag. 181. (*b*) Aphor. 66, & 67. Sect. 5.

(*c*) De Fracturis, Charter. Tom. XII. pag. 249.

“ all searching with the probe, or any other irritating
 “ means, must be rejected: for generally wounds are
 “ at their worst state on the third or fourth day, &c.”

For the same reason he advises (*d*), when a bone is fractured in the wound, that it ought to be replaced the very same day or the day following; but not at all on the third, fourth or fifth day.

Thus Simeon and Levi, to be revenged for the ravishment of their sister, persuaded the Shechemites to be circumcised, and then on the third day after circumcision, when their wounds were inflamed and painful, they securely destroyed them all by the sword (*e*).

But the panniculus adiposus under the skin easily distends and forms a tumour; as appears in fat people, dropsies and emphysematous tumours, in which latter the air is forced into the cells of the adipose membrane, and distends it enormously. For the skin which confines the cellular membrane is like a tight bandage upon it, so that when the former is divided, the latter is protruded up into a tumour in the wound from the contractile force of the skin; so that by the contraction of the skin, and the protrusion or rising up of the fat, the lips of the wound are turned outward, and the bottom rises upward. At the same time the distending impetus of the blood and juices not being diminished, the impervious vessels will be dilated; and from hence again the tumour of the lips will be increased, and the panniculus adiposus caused to degenerate into a sort of fungous flesh.

6. At the same time a slight fever, with heat and thirst, invades the patient.

That is when the wound proves any thing considerable; otherwise there seldom happens any fever in a slight wound. When the symptoms before enumerated (numb. 5.) appear in a large wound, the heat

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and

(*d*) Ibidem, Charter. Tom. XII. pag. 252.

(*e*) Genesis, cap. xxxiv.

and inflammation increase and spread throughout the body, the pulse becomes quicker, and the patient is watchful and restless, his thirst also becomes more intense, and his urine high coloured. All these symptoms continue as long as the tumour, pain, and inflammation last in the wound, and cease when these disappear: but so slight a fever as thus happens in the inflammatory state of wounds does not often prove hurtful, but is rather serviceable by forwarding the formation of pus or matter in the wound; and when the pus is formed, the fever generally vanishes. When this slight fever arises about this time, after cutting for the stone, amputating of breasts, or in the like wounds, it is always a good presage,

Hence Hippocrates observes (g), *circa puris generationem, dolores ac febres magis accidunt, quam (pure) factio*: “that the pain and fever in wounds happen “more when the matter is forming, than after the “suppuration is effected.”

But it must be observed, we are here treating of the slight fever arising at this time from the wound only as the cause; for wounded people may have fevers from many other causes. And even after the matter is concocted and formed in large wounds, being made in great quantity, and absorbed or returned into the blood by the bibulous veins, a hectic fever often follows thence, which by degrees wastes and destroys the whole habit.

7. Hence about the third or fourth day sooner or later, the wound is replenished with a thick, white, tenacious, and oily or uniform matter, called *pus*.

Immediately after the inflicting of the wound it discharges blood, and when the orifices of the divided vessels are contracted, they discharge a red serum or ichor, and then follows the inflammation of the injured

(g) Aphor. 47. Sect. Tom. IX. pag. 85,

jured parts, with the vulnerary fever as before described: and lastly, appears as unctuous and uniform matter in the wound, of about the consistence of cream of a yellow colour, smooth and inodorous, having the taste of chyle or milk, and is called *pus*, which when laudable or good has all the preceding qualities. But this kind of matter is never formed in wounds unless they are secured from the air, either by the natural crust formed on the surface of wounds or by plasters and dressings, &c. So that the matter is not formed within but out of the vessels in the cavity of the wound, from the juices there extravasated, digested, and changed by the heat of the body. For if all the matter be cleansed from the surface of a wound with soft scraped lint, within an hour afterwards it will appear all over beset with a thin liquor instead of matter: but when the wound has been covered with a plaster for four and twenty hours, upon removing the dressings plenty of matter appears. Whence it follows, that the formation of matter is without the vessels, of the extravasated juices brought to the wound.

The matter thus formed has many considerable uses in wounds; for this is the means used by nature to separate the dead lacerated and morbid parts from the sound, to cast off the impervious extremities of the inflamed vessels and make them unite; so that under this matter the incarnation and consolidation of the wound is effected.

Therefore says Hippocrates (*b*), who always follows nature, “ recent wounds (*ἐκληα νεότερωτα*) become very “ little inflamed if they quickly suppurate.” And then adds, that a wound inflicted by a sharp dart may be cured without suppuration; but contused and amputated flesh will putrefy and turn to matter, and afterwards new flesh will grow up in their room.

In the same place he also says, that the inflammation in wounds happens when they tend to suppuration, and

(*b*) De ulceribus in initio. Charter. Tom. XII. pag. 131.

and that the suppuration is performed by the heat and alteration of the blood, 'till it is converted into the putrid matter we observe in wounds. But he does not here seem to mean the putrefaction which happens in some wounds, by a malignant state of the juices, but only that change of the humours by which they are converted into good matter, as is very evident from considering the passage.

Hence laudable matter affords a very good sign of success to the Surgeon: infomuch that Galen(*i*) pronounces, (*nihil mali posse accidere ulceri pus procreanti*) “ that no ill accident can happen in an ulcer or wound “ that generates matter.”

Laudable matter is formed when the healthy juices are brought to the wound with regular motion; and therefore the appearance of it is a sign of the person's health, and the good condition of his habit of body: for in one who is cacochemical, the wound seldom forms good matter, but is rather an ichor or corroding juice, which very often renders the cure of those wounds very difficult, even though they were slight. Such habits of body were therefore termed *δυσία* by the ancient Physicians: and on the same account Hippocrates(*k*) says, *Hydropicis orta in corpore ulcera non facile sanantur*: “ that ulcers or wounds in dropical people are very difficult to cure.” If on the other hand, the fluids are moved too impetuously by a fever, the wound will then appear dry without any matter on its surface; but if the vital powers are too languid, the matter will again be deficient in the wound from the opposite causes; and hence it is that Hippocrates* enumerates the driness of a wound or ulcer among the fore-running signs of death.

8. At the same time the redness, heat, pain, tumour, and distortion of the wounded parts either cease or greatly diminish.

For

(*i*) Comment in Aphor. 22. Sect. 5: Charter. Tom. IX. pag 207:

(*k*) In prognost. & Conc. No. 496,

* Ibid.

For all these symptoms arise only from the orifices of the divided vessels contracting by their elasticity, so as to deny a passage to the circulating juices impelled to the part whence the tumour, heat, pain, redness, and inflammation. In the mean time the panniculus adiposus being unconfined by the contractile skin, it receives juices into its dilated vessels too gross to circulate, whence it becomes tumid in the fundus of the wound, and distorts or turns back the lips. But the obstructed ends of the vessels being digested off in the suppuration with the impervious juices so as to form matter, the vessels are thus again restored to their free course, and the juices to their circulation through them, and therefore all the symptoms arising from the inflammation of the fundus and lips of the wound, consequently vanish or greatly diminish upon the formation or appearance of matter.

This state of a wound is usually called its digestion or suppuration by Surgeons: and when they see the tumour of the parts subside, they say the matter flows well and dissolves or digests.

9. Then the cavity of the wound gradually incarnates or fills from the bottom upwards, and from the sides towards the center, with a new, red, and living substance called flesh, which at length meets together or terminates in a white or livid margin, which is soft and even.

When a good digestion has preceded, all the parts which will not unite and grow to the living, are thereby separated from the sound vessels, and the wound is then said to be clean, its surface appearing then to be even, moist, and perspirable, without any dry asperities either in the bottom or lips of the wound. And then begins the state of incarnation or healing in the wound. For after this, we daily observe the bottom and sides of the wound to fill up with new flesh under the

the soft matter, which is a natural balsam; which new formed flesh sprouting up equally in every point of the wound, appears by the microscope to be an elongation of the soft pulpy extremities of the divided vessels. This is what Surgeons call the incarnation of the wound: not that it is properly muscular flesh that is thus regenerated, but it is substituted in its place, and has always been denominated by the name of flesh. This state is best observed in wounds that have a loss of substance; as when a piece of the skin and subjacent fat is cut out by a scymitar: for there we first observe a congeries of repullulating vessels in the bottom of the wound, which at length also appear to shoot out from the sides, and uniting with the former, exactly fill up the cavity in a very surprising manner by the help of nature only; for art does nothing in this respect, only to remove the impediments with proper dressing, and the rest follows from the natural fabric and mechanism of the parts. That this is thus performed we all know; but the manner how it is done we are altogether ignorant of. (1) Galen has well expressed himself on this head when he says, *Cognosci debet circa carnis generationem quod materies illius sit sanguis bonus, opifex vero & author natura*: “That we are to understand the matter of regenerated flesh arises from good blood, but the author or workman thereof is nature.” This he says, after speaking on the method of incarnating hollow wounds and ulcers. But the Ancients were unacquainted with the wonderful structure of the vessels lately discovered by the Moderns, and of which our whole bodies are composed. But even those who are well versed in anatomy, are to this day ignorant of the manner in which the vessels elongate and grow together, so as to repair the lost substance in a wound; for they not only unite but conjoin regularly, arteries with arteries, nerves with nerves, and veins with veins, in order to form a substance similar to the lost flesh. We can only

(2) Meth. Med. Lib III. cap. 3. Charter. Tom. X. pag. 59.

only adore the infinite wisdom of the Creator, who has furnished the human body with such surprising faculties.

While the incarnation is performing in the cavity of the wound, the lips or sides, which were before tumid, subside and become even, and the margin of the wound acquires a pale or light blue colour like pearl, and that lays a foundation for a future cicatrix, which is gradually increased towards the center, 'till the whole wound is equally closed.

-And this is the natural and most perfect method of healing a wound.

10. Lastly, the wound is cicatrised or spread over with a cicatrix.

When all the lost substance is regenerated in a wound, and the several parts are united which were before divided, the whole surface of the wound then appears dry, though it was before moist in every point.

If now there was no great loss of substance, nor much of the skin and fat destroyed by the suppuration, the parts will thus be so perfectly consolidated, that there will be very little difference betwixt the adjacent skin and that of the wounded part, which then scarce deserves the name of a cicatrix. But when a large portion of the skin and subjacent membrana adiposa are destroyed by the suppuration, then the part wounded will appear more white and compact, and frequently more depressed than the neighbouring skin; and then it is denominated a cicatrix or scar, which is always less perspirable, and more compact or smooth than the skin of other parts. This is very apparent after the amputation of breasts, and the extirpation of large steatomatous tumours, where a large portion of the skin being removed, a cicatrix is consequently formed; and then the surface of the wound

wound lately healed appears splendid, smooth, and firmly adheres to the subjacent flesh.

Thus have we described the history of a wound inflicted on a healthy body, and also given an account of every thing that has been remarked by a faithful observation in its whole progress, from the very first infliction thereof, 'till it is perfectly consolidated or healed; so that from thence may be deduced the most certain method of treating and healing wounds, in imitation of nature herself, *viz.* by removing every thing injurious, and by supplying what we see wanting to the wounded parts. But as we before observed, this doctrine relates only to such wounds as are not inflicted in very tendinous parts, and in which none of the larger arteries are divided: our next business will therefore be to examine, what alteration will be made in the appearance of a simple wound, when any of those two parts are also injured.

S E C T. CLIX.

IF an artery that is totally divided transversely, be neither very large nor too near the heart, the ends thereof flying back or receding from each other, and contracting within the adjacent solids, that artery will thus stop itself, and the rest of the appearances (158) will then follow, as before.

While the blood is impelled by the force of the heart into the arteries, which are continually lessening in their diameters, by striking on their sides, it will remove them from the axis of the canal, so as to increase the capacity of the vessel; but then this dilatation of the arteries will be (*cæteris paribus*) larger as the resistance about their extremities is greater; and from hence it happens that an artery, which has been tied, swells so much more than the rest, betwixt the heart and the ligature. This dilatation of the arteries then

will be resisted by the pretty strong action of the muscular fibres which are disposed circularly about the artery, whose diameter they perpetually contract to its former demensions, so soon as the impelling force of the heart ceases; and therefore when an artery has been divided in a wound, its blood runs out through the open orifice thereof, 'till the resistance of the blood, propelled by the heart, being thereby diminished, the cause or power dilating the artery will from thence also be lessened, in consequence of which the contracting power of the orbicular fibres, which every moment endeavour to lessen the diameter of the artery, will by degrees close its divided orifice, if the artery was not over large. Add to this, that the longitudinal fibres contracting themselves more than usually, from the same causes, will diminish the length of the divided artery, so as to cause its ends to recede from each other, and conceal themselves within their adjacent solid parts, by whose weight and resistance they will be still farther compressed and closed; and if while this is performing, a large quantity of blood be discharged from the wound, the force of the heart being thereby lessened, and the impulse of the blood diminished, the contraction of the wounded artery will from hence again be increased.

When the great toe has been amputated by one blow with the chissel, I have seen the two lateral arteries project out beyond the surface of the wound near a line in length; but after the blood has been permitted to run freely for a few minutes from the divided vessels, they then began sensibly to contract themselves, so as to diminish the hæmorrhage: and when the dressings were removed two days after, not the least blood followed, the extremities of the arteries being then closed; but yet was the wounded artery to be very large, or pretty near the heart, this contraction would not be sufficient to resist the strong impulse of the blood, which would therefore continue to flow even unto death; for the less the artery, and
the

the more remote from the heart, the weaker is the blood's impulse which it receives from that muscle, and the greater are the resistances.

S E C T. CLX.

BUT if the same artery (159) wounded transversely, be not totally divided, by the contraction of the fibres, the wound will be dilated or enlarged, from whence a continual hæmorrhage follows; and even when that is stopped, an aneurism follows from the yielding or small resistance of the thin cicatrix.

In this case, for the reasons before mentioned (§. 158. numb. 1.) the divided parts of the wounded artery will continually recede farther from each other, with the parts of the wound; but as that vessel is entire, or adheres together on one side, the extremities thereof are thus prevented from flying back and contracting themselves within the adjacent parts: nor are the orbicular fibres then able to contract its diameter so as to close the wounded artery; the blood therefore meeting with no resistance in the wounded part of the artery, and finding a considerable one in the other entire vessels, continues to run from the wound, even 'till the patient faints or dies. But it frequently happens that the hæmorrhage does not continue even unto death, but only 'till the patient becomes very weak and faint; after which, a thin cicatrix begins to form itself in the wounded part of the artery, which, though capable of retaining the blood now moved very weakly by the heart, yet is not able to sustain the impetus of the blood when the patient again recovers his strength; but by giving way, or resisting less than the rest of the artery, it then forms the tumour we call an aneurism (*i. e.* the dilatation of an artery); because that vessel no longer retains its equable and

conical figure in the part affected, but is distended into a kind of sacculus. Now as the amplitude or capacity of an artery depends on two causes, *viz.* the force with which the blood is impelled from the heart to dilate the same, and the resistance of the sides; therefore the amplitude of this vessel may be estimated (as we observed §. 26.) in a ratio compounded of the blood's impulse directly, and of the resistance of the sides of the arteries inversely: from whence it evidently follows, that an artery being rendered weaker in one part than another, it must of necessity be in the weaker part more extended; but as from this extension continued, the affected part of the artery is more and more weakened, we may from hence see the reason why aneurisms frequently arise to so large a bulk as the writers of observations sometimes inform us by instances.

S E C T. CLXI.

BUT if the artery totally divided be large, an incessant hæmorrhage follows, 'till the patient either faints or dies; the parts below the wound fall away if he survives, and are consumed either by a slow gangrene and mortification or else drying up, they become totally withered and contracted.

Here the blood flows from the wounded artery with an accelerated and full stream, not equally swift but by starts, first with a greater, and then with a lesser impetus; because during the time that the arteries are in their diastole, only that force of the heart which urges the blood forwards in the vessels will discharge it from the wound: but a great part of the impetus of the blood, received from the heart, is spent in dilating the arteries, so that during their diastole the blood will be propelled by the excess of the force with which

the heart overcomes the resistance of the arteries: but when the action of the heart ceases, the arteries contract and protrude the blood with a much greater celerity, by which it acquires that bright purple or scarlet colour with which it appears in the hæmorrhage, and from these two circumstances we know whether the blood runs from an artery or a vein. A vein too, when wounded, even though it were a large one, discharges its blood very slowly, (except in those who are very plethoric) always appearing blacker, or of a more obscure red colour. If the artery wounded was large, and very near the heart, death speedily follows from all the blood discharging itself in a little time from the wound; but this is not always the case, for frequently the patient bleeds only *ad deliquium*, in which state, if they are not revived with wine or cordials, but continue in appearance almost dead, there is then some hopes of a recovery from the remaining *vis vitæ* though very weak, and the divided artery may then contract and close itself. Of this we have a surprizing instance usually related by professor Boërhaave to his audience.

A countryman of a neighbouring village being in his cups, was wounded with a knife in the armpit, so as to divide the axillary artery, whence the blood followed with an incredible velocity, and he falling down soon after, was believed and laid out to be dead; but on the next day, when those who were appointed by publick authority came to examine his body, that they might make a report concerning the mortality of this wound to the proper judges, they then found that there was some warmth still remaining about his thorax, without any other signs of life, and therefore they deferred the examination of the wound for some hours, during which time the wounded person, which every one imagined would totally expire shortly, began sensibly to recover himself; so that notwithstanding his continuing so long in such a very low, weak, and almost lifeless state, he recovered be-

yond the expectation of every one, but then the arm of the wounded side continued dry and withered, almost like a mummy, all his life-time afterwards. If therefore so large an artery, and so near the heart, could be thus closed, we may from hence conclude, that one ought not easily to despair in the most dangerous wounds of the arteries, provided the weakened *vis vitæ* in the wounded patient, be not roused or stimulated by wine and cordials; for without these, perhaps mere wounds might escape than we otherwise find.

If now the parts below the wound were supplied with blood from no other artery but the large one totally divided, it follows, that they must be absolutely destitute of all influx of vital juices, whence the death or destruction of the parts, which may be effected two ways; either (1.) by the stagnation and corruption of the juices already in the vessels, but now no longer moved by the force of the heart and arteries, whence a putrefaction and slow gangrene; or (2.) the juices left in the vessels of the parts below the wound, after the division of the large artery, are propelled into the veins by their own proper contraction, and by the action of the adjacent muscles, so that they return to the heart without any juice being sent by the heart into the parts again, whence the vessels being gradually deprived of their juices without any fresh supplies, collapse, or shrink and grow together; and as the greatest part of the bulk of our body results from the several juices with which our vessels are distended, therefore the parts shrink so incredibly, and become so much withered and contracted, as in the instance before alledged.

S E C T. CLXII.

ANY of the large and tense nerves being totally divided, their extremities recede or fly back from each other, and hide themselves in

the flesh, while those branches spent in the part above the wound being hereby drawn up and stretched, cause pain and obstruction in the adjacent parts above, while those parts below the wound are either benumb'd, insensible, immovable, or destroyed by a gangrene.

We shall here consider the symptoms which appear when any of the larger nerves are wounded. There is not any wound that can even penetrate the skin, without dividing an infinite number of nervous fibres; but these we have nothing to do with in this place, where we intend only to examine the larger nerves, which are shown by anatomists to be fasciculi of smaller nerves covered with a common integument.

Fly back, &c.] That part of the larger nerves, which is more properly the nerve itself, appears to be a continuation of the tender pulp or medulla of the encephalon, and therefore does not seem to be firm enough to fly back with an elastick force after division; but the nerves, which are so very soft at their origin from the medulla oblongata and spinalis, are in their progress invested with tough coats to defend and convey them safely to their respective parts of the body in which they are spent. It is then from these integuments that the nerves receive their firmness and elasticity, in so much that the knife of the anatomist finds a considerable resistance in dividing even a small twig or thread of a nerve; and were they not thus firm, it would be impossible to trace and demonstrate the nerves, especially after they divide themselves into small branches. When a large nerve therefore is divided, the extremities are by the contractile force of its integuments, and the vessels therein distributed; with drawn from each other, under or into the adjacent fleshy parts. But the larger the nerve, the denser (*cæteris paribus*) are its coats; and as the smaller nervous fasciculi composing the body of every large nerve are also each of them invested with a proper integument

ment dividing one from the other, therefore large nerves being divided, contract their extremities with a very considerable force.

Branches spent, &c] The nerves are distributed into branches like the arteries and veins; but though the branches either of an artery or vein always communicate with the cavity of the trunk from whence they arise, so that the liquor they convey may pass in a continued course from the trunk into the branches; yet there is a quite different mechanism in the larger nerves, which in like manner divide themselves into smaller branches; for one of those larger nerves consists of an infinite number of smaller bundles of nerves bound together in a common integument, which bundles are again composed of other lesser ones; nor has the dexterity and industry of anatomists, been as yet able to discover how far this subtle division of them into lesser nervuli proceeds. But in the course of a large nerve, it continually sends off some of its constituent fasciculi of nerves every way, which are called the branches of a large nerve; not that the same substance of the nerve is propagated in a continued course, like the substance of the arteries and veins, but those small nerves which were before united with others like themselves, under the form of a large nerve, are now separated from each other, and sent each a different way to its respective part for some action; all the nerves therefore, which are derived as branches into the larger nerves, were distinctly such even at the origin of the large nerve, from the medulla oblongata and spinalis; whereas in the arteries and veins the branches take their origin at the larger trunks, from whence they arise and are ramified.

When any large nervous trunk therefore is divided, by its flying back, it will at the same time draw or stretch those nervous branches which arise from the same trunk a little above where the wound was inflicted; from whence will arise violent pains in the adjacent parts, into which those nervous and violently

distended fibres were dispersed; and very often the pain is much greater in the parts adjacent, than in those of the wound itself; but that excruciating pains may arise barely from such a distention of the nervous fibres we are convinced by various observations. While a phlegmon or inflammation invades and distends the *membrana adiposa*, before it comes to suppuration, it elevates the skin and distends the nervous fibres thereof with the most intense pain; but the suppuration being afterwards compleated, and the skin opened by the the Surgeon's lancet, all the pain instantly ceases, while the matter which distended the skin is discharged. How excruciating is the pain arising from an inflammation and tense tumour distending the very nervous membrane of the auditory passage? And while the substance of the tumified bone distends the *periosteum* in the venereal disease, so great is the pain, that the patient very often lays violent hands on himself.

We are also to consider, that the coats investing the large nerves and their branches, are all spread with an infinite number of small vessels, as we are at this day convinced from anatomical injections; now those nervous branches of the wounded trunk cannot be distended or stretched by the recession of the trunk, without distracting and elongating the small constituent vessels of their integuments at the same time; and we have demonstrated before, (at §. 112. numb. 3) that every cause which too much distracts and elongates the vessels will diminish their capacities or diameters, from whence will follow obstructions, with all its consequences.

An insensibility or numbness of the parts below the wound, &c.] The nerves are observed to have very distinct offices in the human body; some nerves give sensation to the parts to which they belong, others are for moving the muscles, and the life and nutrition of the parts seem again to be the office of other nerves; but that the different actions are performed by different

rent nerves we are evidently taught in diseases, for very often particular palsies, and even an hemiplegia happens, so as in the last to destroy all the action of the voluntary muscles in one side of the body, without destroying the sensibility, warmth, and nutrition of the affected parts; and therefore we have here great reason to hope for a cure. Sometimes again the sense of a part is lost with its motion, in a palsy, so that the affected part does not any longer seem to the patient to be a member of his body, but he feels objects by it as if he touched them with a stick, and in that case the disorder is much more difficult to cure: but when the paralytic part is also cold at the same time, and the fleshy substance thereof begins to shrink or waste, the disorder is then almost constantly incurable; as we are assured from many lamentable instances of palsies following the colica pictonum, in the Indies. But notwithstanding these nerves arise distinct from each other in the brain, and are destined for distinct offices, yet they are bound together as it were into a fasciculus, as they pass in the larger nerves to their respective parts; whence such a compound rope of nerves being totally divided, all the several functions, depending on those nerves when intire, will be abolished: hence then will follow a stupor or insensibility of the parts below the wound, as also an immobility and numbness of them: unless the parts are furnished from the nervous trunk above the wound, or except other nervous trunks afford branches to them.

But perhaps the reason may not seem quite so evident, why the parts below the wound are so often infested with a gangrene, after one of the larger nerves has been totally divided. Now a gangrene is termed that affection of the soft parts in which they tend to death or mortification, from a deprivation of their vital influx and efflux of the juices by the arteries and veins; and therefore if a gangrene follows the total division of a large nerve, it must hinder that vital influx and efflux of the juices; yet we know the arteries

and veins are here entire, and their contained juices in a healthy state, and the nerves only appear divided; but if we again consider that the motion of the arterial fluid results from two causes, *i. e.* the force of the heart and the actions of the arteries, and also remark that the force of the heart is spent chiefly in dilating the arteries, it will thence follow, that the principal cause moving the fluids in the arteries must be their contraction, which is performed partly by their elasticity, but principally by the action of their round muscular fibres, by which the dilated arteries are again contracted; but we know from physiology, that the action of a muscle or muscular fibres requires that the nerve thereto belonging be sound or entire; and as we know that the nervous trunks give branches to the adjacent arteries, it is thence evident that the nerve being wounded or destroyed, the muscular force of the artery propelling the contained juices must also perish, so that the blood will move on in such an artery only by its remaining elasticity, and the impetus received from the heart. In the veins again the blood goes on with the velocity which it had in passing into them out of the arteries, which is again accelerated by the motions of the adjacent muscles, swelling in their contractions, and pressing the adjacent veins so as to promote the course of their contained blood; but the nerves being divided, the subjacent muscles become paralytic, whence this action of them is destroyed. Thus the impetus of the blood being diminished, in passing from the arteries through the veins, for want of the protrusive action of the adjacent muscles, it will therefore stagnate or move slower in the veins, and be there accumulated; from whence again will arise a greater resistance to the arteries, whose muscular contraction is now much weakened, from which causes the vital motion of the juices through the arteries and veins into the parts below the wounded nerve, will at length be totally destroyed, that is, a gangrene will follow.

Thus

Thus have you a rationale of those symptoms which are observed to follow a total division of any of the larger nerves; and that these consequences do follow in such wounds, we are assured from the daily practice and observation of Surgeons and Physicians.

A healthy old man, in his sixty-fourth year, fell down from a high place with such violence, that his spina dorsi striking on the corner of a sharp stone, he the very moment after lost all sense and motion in all the lower parts of his body, beneath the margin of the lower ribs, from the injury which the spinal medulla received in so high a part of it. All means being tried to no purpose in this case, on the sixth day a gangrene infested both his lower extremities, and on the seventh day he expired.

A case of the like kind I observed in a young man of twenty years old, whose disorder was seated about the last vertebræ of the loins; he lived in misery for about seven weeks, but both his nates, with the soles of his feet and heels, were infested with a frightful gangrene.

S E C T. CLXIII.

ANY of the tense nerves or tendons being punctured or half divided, there follows either an obtuse or excruciating pain, which appears first in the wounded parts, and then spreads through all the communicating nerves and adjacent parts; from thence arise heat, tumour, and redness, extending themselves very largely, and at length follow inflammation, fever, delirium, and convulsions, while from the mouth of the inflamed wound is discharged a sharp, thin, and sometimes much of a serous juice; these again terminate either in a rigidity, insensibility, immobility, and withering, or drying up of the limb, or else in a gangrene
and

and death. And all these symptoms are the more violent, as the injured nerve is more tense, or strongly extended upon the solid parts to which it is connected, and according as the integuments investing it are more firm and compact.

So calamitous are the cases where such direful symptoms arise frequently, even from a slight wound. It sometimes happens, that the tendon of the biceps muscle is injured in opening the vein of the arm; but more frequently the broad tendinous fascia or aponeurosis springing from that tendon, and investing all the muscles of the cubitus, is wounded by the lancet, at which instant arises an intolerable pain, which the unfortunate patient immediately expresses, by crying out aloud. When Charles the ninth, king of France, was bled by order of his Physicians, the lancet was no sooner entered, but the acute pain made the king cry out lustily, after which his arm presently swelled, so that he could neither bend or extend it at the elbow without great pain; the pain was most acute at the puncture, and from thence it soon spread thro' the whole arm; but the wound being dressed with warm *oleum terebinthinæ*, mixed with a little *spiritus vini rectificati*, by that means, and with other proper remedies, the king's arm was perfectly recovered in the space of three weeks time. *Parey's Surgery*, Book xii. cap. 41.

Sometimes in the beginning of such an accident the pain seems slight or dull, but after a few hours it increases greatly, extending through the whole arm to the shoulder, and sometimes the subaxillary glands are also suddenly inflamed and swelled; the patient in the mean time complains of a pain like the burning of fire in the wounded part; and when long red spots appear externally in the skin, it is almost constantly reckoned one of the very worst signs. When the flexor tendons of the fingers are affected in the malignant species of a paronychia, a red circle appears in the
skin

skin of the cubitus, extending itself longitudinally according to the course of the muscles which bend the fingers, and is always judged a very bad sign by the most skilful Surgeons; for it is very often followed with a most acute fever even in healthy constitutions: and partly from the fever, with the perturbations of the encephalon from the intensity of the pain, there follows a delirium, and, after convulsions, death. Ambrose Parey gives an example of death following the puncture of a nerve, in the place before cited. And Hippocrates relates (a), *Quod homo sibi ipsi subulam ad digiti longitudinem in femur supra genu adegerit: nullus effluebat sanguis, vulnus cito clausum fuit, totum femur intumescebat, & tumor extendebatur ad inguen & laterum molitudinem (μεγεθυον) tertio autem die mortuus est. Alter acuto telo posterius paulo infra cervicem vulnerabatur: vulnus autem accepit vix effatu dignum, non enim alte penetrabat: non longo tempore postea evulso jaculo contrahebatur uti solent opisthotono correpti, & maxillæ claudebantur; & siquid liquidi assumeret ore, & deglutire tentaret, redibat per nares: reliqua omnia deteriora fiebant; secunda die mortuus est.*——“ That a
 “ man having thrust a bodkin as long as one’s finger
 “ into his thigh above the knee, there was no blood
 “ came from the wound, but it closed presently; yet
 “ the whole thigh swelled, and the tumour extended
 “ to the inguen and side of the abdomen; and on the
 “ third day he died. Another man was wounded
 “ with a sharp pointed weapon in his back, a little
 “ below the neck: the wound received ‘was scarce
 “ worth mentioning, for it did not penetrate deep,
 “ yet when the instrument was extracted soon after,
 “ he was contracted or convulsed backward, like those
 “ who are seized with an opisthotonus, and his
 “ jaws were clinched; when he took any liquor into
 “ his mouth, endeavouring to swallow the same, it
 “ returned again through his nose: in the mean time
 “ he grew worse in all other respects, and died on
 “ the

(a) In Epidem. Lib. v. Charter. Tom. IX. pag. 343. & seq.

“ the second day.” Many of the like melancholy cases are to be found in the writers of observations.

But though death does not always follow such injuries of the nerves, they are generally attended with the very worst of symptoms; the whole limb is much swelled and inflamed, and by the elevation of the cuticle into blisters, or by the dilatation of the wound, there is discharged an immense quantity of a thin ferrous liquor both day and night; but the patients feeling a pain like that of burning, they therefore accuse the draining serum or ichor with acrimony; when in reality, no acrimonious taste can be perceived in the said liquor. Sometimes a gangrene eats away the whole panniculus adiposus; nor does a mild suppuration ever succeed in this case, but sinuous collections of ichorous matter consume all the fat interposed betwixt the muscles, and destroy the adipose sheaths or capsules of the tendons, whence the skin afterwards adheres or grows to the muscles and their tendons; so that by a concretion of the muscles to the skin and to the adjacent parts, for want of the cellular membrane to part them, the use of the whole limb is lost, and it becomes rigid or immoveable. The coats of the nerves being also destroyed either by an obstinate gangrene or suppuration, (for the cellular membrane is also found in the coats of the nerves) those nerves lose their action, become insensible, benumbed, &c. How surprising is it, that a slight puncture of a nerve should even in a healthy body produce such a disturbance in all the fluids, excite such enormous pains, and totally destroy the use of so many parts, even though the wound be slight! The reason of all which appearances we shall give hereafter at §. 181, & seq.

But it ought particularly to be observed, that all the symptoms happen more violently as the nerve injured is more tense or extended; whence it is, that punctures are so dangerous about the last phalangi of the fingers, where the strong tendons are inserted; and in the palm of the hand where the tendinous ex-
panfion

Panision of the palmaris muscle, forms a sort of tense and hollow concavity. The malignity of the symptoms will be still increased, if the nerves injured are invested with tough integuments, as may appear especially in the worst species of the paronychia, where the tendon inserted into the last phalanx or bone of the finger being punctured, or inflamed from any other cause, often excites the most excruciating pains, delirium, convulsions, syncope, and even death itself very suddenly; or if the patient escapes after such direful torments, he loses the last bone of the finger by a caries; and the hand sometimes becomes contracted together with one's fist, remaining ever after an unhappy and incurable memorial of the disorder, so long as the patient lives. The reason of all these bad consequences and malignant symptoms arises hence, because the tendons which bend the last phalanx of bones in the fingers, are strictly confined or invested by an extraordinary sort of ligament, almost as hard as a cartilage; and if in the beginning of the malady a skilful Surgeon boldly divides all the incumbent parts to the bone, he will by that means also divide the theca or including case of the tendons, whereupon the stricture and pain will abate, and all those direful symptoms will be prevented.

S E C T. CLXIV.

THESE same symptoms (162 and 163) will be found to take place with a little variation, in tendons variously injured, in which too they are equally severe.

In the tendon of a muscle may be distinguished as many fibres as the muscle itself can be divided into; betwixt which fibres are interposed an infinite number of small vessels, as we are taught by anatomical injections; but these small fibres of the tendon seem to be only continuations of the muscular fibres, which
arise

arise from the nerves entering the muscle (*V. Instit. Med.* §. 395.); and therefore from hence we need not wonder, that injuries of the tendons should be attended with the like symptoms as a wounded nerve, since they are a continuation of the nerves. Add to this, that as we observe the larger nerves furnished with the cellular membrane and with vessels of all sorts, separating the nervous fibres from each other, so we also find the same membrane and vessels distinguishing the fibres of a tendon: but as the tendons serve only for moving particular parts, while the nerves are also subservient to sensation and nutrition in most parts of the body; therefore we do not meet with all the symptoms of wounded nerves in injuries of the tendons, yet are there many appearances similar in both cases, many of which are however observed to be more violent in punctures, or injuries of the tendons.

When a nerve is totally divided, it does not excite much pain, unless the small branches arising from it above the wound are over-stretched by the contraction of the divided trunk; but then all the parts below are deprived of all the actions arising from the nerve entire. And in the same manner when the tendon is totally divided, the motion of the part is destroyed, which depended on the tendon when sound; frequently also there is no more pain in such a division of a tendon, than is common in every simple wound, nor does any worse symptoms follow, as I observed in a man who had the tendons of the extensor muscles of his fingers divided with a knife. We have a remarkable case, confirming what has been said, given us in the *Mem. of the Royal Academy of Sciences*, (*An.* 1722. *pag.* 70.) where a very active dancer endeavouring to raise himself by leaping with a great force, broke asunder both the large tendons of his heel, termed the tendons of Achilles, the skin in the mean time remained entire; but the ends of the broken tendons were contracted to the distance of three fingers breadth from

from each other. These tendons were afterwards reduced and consolidated by proper bandage and dressings, nor did the patient perceive any pain either at the time of the accident, or during the whole course of the cure.

In another man, the skin also remaining whole, the same tendon was broke in two in that part arising from the gastrocnemii muscles, while the other part of the tendon, springing under the former from the soleus muscle remained entire; and in this case there was a violent pain, inflammation, and tumour of the limb: (*Mem.* 1728. p. 331, &c.) from whence it evidently follows, that a tendon, being only half or imperfectly divided, is attended with much worse consequences than if it was totally cut through.

The most cruel symptoms arise even from slight wounds of the tendons; and even from a slight pressure or touching of a tendon, not covered with its capsule, the whole nervous system is disordered in a moment throughout the whole body; which is more than a little surprizing, since the same tendons covered with the integuments of their capsules (especially their adiposa vagina, or sheath, furnishing a soft oil to lubricate each tendon in motion) may be forcibly pulled or even sewed together without any grievous symptoms. For it is well known among Surgeons, that the ends of divided tendons may be apprehended and drawn together by pliers, and then retained and conjoined by suture with a thread, the cure then succeeding very happily by only disposing the muscles whose tendons are divided, so as to remain relaxed or flaccid. But when a tendon is denudated of its capsule or integuments, the most horrid symptoms follow if you do but slightly touch it.

A certain nobleman had a violent inflammation in his leg, from the knee to the ankle, which was also accompanied with an intense fever, and being of a bad habit of body, there was but little reason to expect such an inflammation would be dispersed; on the
contrary.

contrary, collections of purulent or ichorous matter was observed here and there, which suppurated a great part of the cellular membrane; and the fat being especially all consumed about the internal ankle, and the capsules of the tendons themselves destroyed, these last appeared naked: in the mean time our celebrated professor Boëhaave admonished the Surgeon to avoid touching them, but his advice being neglected, the Surgeon lays hold of a tendon to pull it off, thinking it a part of the cellular membrane; the consequence was, that the patient became that very moment convulsed from head to foot, with a frightful gnashing of his teeth, and thus did he continue stiff and contracted for some minutes.

Old Hippocrates gives a terrible instance of this kind, (*in Epidem. Lib. V. Charter. Tom. IX. pag. 348, ult.*) telling us, *Thrinon, Damonis filius, circa tibiæ malleolum ulcus habebat; juxta nervum jam purum erodente medicamento illi appposito contigit opisthotono correptum mori*; “ that Thrinon, son of Damon, having
“ an ulcer near the internal ankle, upon applying a
“ corrosive medicine to the nerve or tendon, now
“ bare, he was convulsed backward and died.” It is highly probable, that by (*νεῦρον καθαρόν*) *nervum purum* he understood the tendon denudated of its capsule, which then looks of a splendid white or pearl colour. A like observation he also gives us in *Epidem. Lib. VII. Charter. Tom. IX. pag. 570.*

To prevent these horrid symptoms in the puncture of a nerve or tendon, we are not yet furnished with a better remedy than the black balsamum peruvianum made a little warm, and then dropt into the wound; and to make the same penetrate and spread more exquisitely through the parts affected, apply a hot spatula over it; and lastly involve the whole limb in mollifying cataplasms or fomentations, or continually rub in some very mild oily medicine; but if the wound proves too small to admit the application of the Peruvian balsam, it may be enlarged a little.

How much warm oil can do in an irritation of the whole nervous system, when convulsions may be thence feared, Galen has informed us upon his own sad experience; for while he was exercising at the ring or wrestling-place, he had the processus acromion distorted from the clavicle; hereupon the master of the field thinking his shoulder was luxated, extended it several times very forcibly, in order to reduce it, but so violently were the muscles extended, that Galen felt thence a sort of convulsion approaching: after this his whole arm was ordered to be bathed a day and a night with warm oil poured thereon, so that the oil running down his arm, held naked during the sultry dog-days in a sort of leathern case, might drop slowly into a subjacent basin, out of which, being collected and warmed, it was to be again poured on his arm as before; but he assures us, that if the oil was but for a little time neglected to be poured upon his arm, he then felt a sort of cramp or convulsion seizing the muscles of his neck.

S E C T. CLXV.

ALSO membranes thus injured, since they are often a production or expansion either of nerves or tendons, are in like manner affected with the same symptoms (162, 163.)

Not all wounded membranes excite such bad symptoms, but those chiefly which are very tense. If that tendinous membrane be injured, which is a production of the broad fascia, that like an aponeurosis invests and confines all the strong muscles of the thigh all the way down from the gluteus; I say if this be punctured, it excites most extraordinary and violent symptoms, and the like accidents are also frequently the consequences after the aponeurosis belonging to the biceps muscle of the arm has been injured in phlebotomy. The very tense membrane, which invests

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the meatus auditorius being distended with an inflammatory tumour, excites the most intolerable pain, which is sometimes followed with a delirium or even death itself; as Hippocrates has justly observed in his Prognostics and in his Prænotiones Coacis. But the injuries of those membranes are most to be feared, which are either productions of tendons, or which, by the vast number and irritability of the nerves distributed through the whole substance, are rendered exquisitely sensible. Such for example is the periosteum, which causes such excruciating pain after it has been injured.

S E C T. CLXVI.

WHAT alteration is made by a wound in the veins, lymphatics, and adipose cells or ducts; with the consequences thereof, may be easily understood from considering the laws of the circulation, with the nature of the adjacent parts wounded.

Lymphatics.] All the vessels which are demonstrated by anatomists under the name of lymphatics, are veins, as we are assured from the course or motion of their contained fluids, passing from the branches into the trunks; as also from their valves, which have been so evidently demonstrated by Ruyfch to Bilsius, who denied that any such valves could be shown in these vessels. These lymphatic veins being wounded do not occasion any great discharge, nor even do the sanguiferous veins, though pretty large, extravasate any great quantity of blood after they have been wounded. But it must be observed, that these lymphatic veins have corresponding lymphatic arteries which being partially wounded, and not entirely divided, occasion a constant and troublesome discharge of lymph in wounds. But that these lymphatic arteries are very numerous, may be concluded from anatomical injections thrown in by the arteries, by which

which means many of these vessels in the part injected become distended and coloured, which in their natural state never appeared to contain any of the red blood; even the tendons and ligaments have been so exquisitely injected by Ruysch, that they have appeared all over red, and therefore these parts contained many lymphatic vessels, which in a state of health were filled only with a thin colourless liquor; hence it may be questioned, whether that lymphatic discharge, which is so frequently observed in wounds of the joints, does not arise from this quarter.

Adipose.] That the fat returns or mixes with the blood, and circulates therewith through the vessels, is apparent even to demonstration; how very much do we observe the fat to be consumed in a few days time, when a corpulent person has been ill of an acute fever; to which we may add, that little drops of oil are apparent to the eye in the blood, which has been extracted by phlebotomy in those diseases. Malpighi observing and compressing the striæ of fat connected to the trunk of the vena portæ, he could then observe little drops of oil pass together with the blood of the vein into the liver: there is therefore not the least room to doubt of this return of the fat; only it may be questioned whether this fat or oil is continually circulating by its proper vessels like the rest of the humours; or whether it is collected and stagnates in its proper cells, which communicate with the arteries by their recipient orifices, by which the oil is separated from the arterial blood, while their emitting orifices communicate both with similar adjacent cells and with veins. which again receive the fat, and mix it with the returning blood and humours. Malpighi, in his treatise of the omentum and fat, seems to have been of opinion, that there were such adipose vessels, which carried the oil or fat in a continued course without any intermediate cells; but in his posthumous works he again says, that the fat is accumulated and retained in proper cells, as if it

were in store-houses, and that though he had been very solicitous in his enquiry after the existence of adipose ducts or vessels, he could not yet assert that there were such. But whether the fat is contained in such cells, connected together and mutually opening into each other, or whether it be contained in proper vessels, it will nevertheless be discharged from both when wounded, so as to putrify and produce many bad consequences. After the death of a horse, which has been violently exercised, if the abdomen be opened, that whole cavity appears replenished with extravasated fat or oil, according to the observation of Ruysch (a); and it is certain, that the fat is of a very lax texture, and protruding itself easily into wounds, gives rise to what we call fungous flesh, especially if the wounded fat parts are too often treated with emollients.

[Veins.] Provided they are not very large, there is no great danger to be thence feared, for they do not excite a profuse hæmorrhage, except in plethoric habits, where it is in some measure serviceable by diminishing the too great quantity of blood, and then the frequent anastomoses of the adjacent veins, by which they communicate with each other, easily supplies the defect of the wounded veins. But we must not neglect to observe here, that when a large vein is wounded, a Surgeon cannot safely apply those acrid styptics without danger, which are generally used to restrain hæmorrhages in wounds, such for example as vitriol, alum, alcohol, &c. for there is danger of those substances entering the patulent orifice of the wounded veins, so as to mix with and congeal the reflux blood, which returning easily to the heart by the continually diverging veins, would notwithstanding be incapable of passing through the small arteries of the lungs, whence might arise very pernicious if not fatal consequences.

[Vesicles.] Such are all the glandular follicles, in the cavities of which is collected some juice separated from

(a) Epist. Anat. ad Herm. Boërhaave, pag. 55.

from the blood of the arteries, which juice is afterwards discharged again by its proper duct for some use; but such vesicles being wounded, it is evident that their uses will be destroyed, the importance of which may be concluded from the known functions of the parts affected; so, for example, if the seminal vesicles be divided, it is evident that the whole business of procreation will be thence interrupted.

S E C T. CLXVII.

WHEN a wound lies open to the sight, the existence and nature thereof may be known, 1. by an examination of it by our senses and eyes, after the hæmorrhage has been stopped, and the other impediments removed; 2. by an acquaintance with the parts near the wound from anatomy.

It is here absolutely necessary as well for the Physician as the Surgeon, to be very cautious in giving their judgment upon a wound soon after they are called to a patient, before they have diligently examined all the circumstances with the strictest attention; for it is very possible, that what he then hastily and inconsiderately pronounced, will be afterwards brought before the judge upon trial. If the wound, which he at first sight pronounced, to be slight and of no consequence, should afterwards turn out dangerous and unhappy in its events, it may be attributed either to the ignorance or imprudence of the Physician and Surgeon who attended the patient; but prudent Surgeons generally interrogate the physician concerning his opinion of the wound, and the consequences which are to be thence feared, by which means they save their own reputation; it will be therefore extreamly serviceable to all, who intend to apply themselves to the practice of physick, to take

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every occasion of being present in all dangerous wounds and operations; by the frequent sight of which, they will become not only more expert, but also more intrepid, so as to enquire into and treat the calamities of mankind without fear and confusion. It is not without reason that Hippocrates advises (a), *Medicus periculosa intuetur, ingrata contrectat, & ex aliorum calamitatibus proprias lucratur miseras, ægrotantes vero per artem à maximis malis, morbis, doloribus, tristitia, morte per artem vindicantur*; “ the Physician, to examine into dangerous cases, to familiarize himself with those which are disagreeable or offensive, as well to help his own infirmities from his knowledge of them in others, as to free his patients by art from the greatest injuries, diseases, pains, anguish, and death itself.”

The advantages which arise to mankind from the practice of physick and surgery relieve these calamities. But it very often happens, that a Physician, extremely well versed in the structure of the human body, is so confounded by the sight of the wound, the cries of the relations, and complaints of the patient, that trembling he pronounces his opinion of the wound very different from what it would have been, if he had serenely considered all the circumstances without any interruption.

1. A wound is therefore to be examined, not hastily, but with the strictest attention of mind; for the Surgeon may observe that in the first dressing, which he cannot conveniently discern afterwards, for after the first day the wounded parts are so much tumified and full of pain and inflammation, that they will not admit of being searched with the probe without much trouble to the Surgeon, and greater uneasiness to the patient.

If the wound is inflicted in such a part of the body as is visible to the eye, all those impediments ought to be first removed, which prevent it from being distinctly examined; in order to this, the wound may

(a) De Flatibus in initio, Charter. Tom. VI. pag. 213.

may be washed with warm water mixt with a little honey, wine, and sea-salt, that by removing all the clots of blood, the whole surface of the wound may be clearly viewed; but so long as the blood continues to run impetuously from the wound, every thing is drowned and obscured, so that the Surgeon can perceive nothing distinctly; hence therefore the hæmorrhage is to be restrained, which may be easily done in the extremities or limbs, by compressing the trunks of the vessels with the tourniquet or a proper ligature; in other parts of the body, if the injured vessels are not very large, the hæmorrhage may be restrained with warm alcohol vini.

2. For without this knowledge nothing certain can be determined; inspection of the wound will indeed teach its size, depth, and course, but the particular parts wounded can be only known from anatomy. The very just tables of Eustachius, in which the origin, course, and distribution of the arteries, veins, and larger nerves, are so accurately represented, may be of great use for this purpose; so that often knowing the part wounded, we may thereby determine what organs are injured, and what accidents or ill consequences are to be thence feared.

S E C T. CLXVIII.

THE existence and nature of a concealed wound is known, 1. from anatomical knowledge, with the posture of the patient, and the manner or force with which the wound was inflicted; 2. from the injured action of the parts following from the wound; 3. from the matter discharged from it either within or out of the body; and, lastly, 4. from the supervening symptoms of pain, hiccough, convulsions, tumour, &c.

It is by much the most difficult to obtain the know-
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ledge

ledge of a wound which lies concealed from the sight; for though we see where the instrument entered the integuments externally, yet we are often in the dark as to how far it penetrated; however, it will be of great service in this case, if we attend to the following particulars.

I. We know from the anatomy of the parts what organs are seated at or near the wound, but then the posture of the patient at the time when he received the wound, as also the position of his antagonist while he inflicted the wound, will in some measure indicate which way the instrument has penetrated within the body; and if at the same we can examine the wounding instrument, we may sometimes determine how far it penetrated by the width of the wound in the integuments. All these are to be diligently enquired after, either from the wounded patient himself, or from those who stood by when the wound was inflicted. If, for example, a wound is inflicted by a sword perpendicularly betwixt the sixth and seventh of the true ribs, it will penetrate into the cavity of the abdomen; or if the patient was leaning backward when he received the wound, the sword would then penetrate from below upward into the cavity of the thorax; but if the sword entered the same part while he was in an inclined posture, it might run through the whole abdomen down to the pelvis; but in a fat person, a wound of the same nature upon the ribs might penetrate a considerable way under the integuments, without perforating the cavity of the thorax. When the Surgeon therefore examines the depth of the wound with his probe, it will be of great service for the patient to put himself in the same posture as he was in when he received the wound, for without that precaution, the *membrana adiposa* very often stops up the way; in the same manner as when a vein is opened in a fat person, it frequently happens that a bit of this membrane protrudes itself by changing the posture of the arm, so as to stop the course of
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the blood, which at first ran very freely from the orifice, but is now obstructed by the intrusion of the fat into parts betwixt the skin and the aperture of the vein.

2. When we are acquainted from physiology, with every thing that is required to the health and action of the several parts of the body, we may easily tell from the impeded or destroyed action of the wounded parts, whether some only or all that is required in the action of the part be injured or destroyed by the wound; for example, if a great weakness of the vital functions immediately ensues after a wound that has penetrated into the cavity of the abdomen, attended with a swift palpitation of the heart, a small, quick, and unequal pulse, paleness of the face and lips, and coldness of the extremities, we may then conclude, that a large quantity of blood is extravasated into the cavity of the abdomen, from a wound in some of the larger blood-vessels. If a wound be inflicted in the neck without any considerable hæmorrhage, and afterwards attended with symptoms like the preceding, there is then reason to fear that the recurrent nerves are injured, as they descend through this part to their distribution in the vital organs. If the like symptoms follow a wound of the head, there is reason to believe that the cerebellum is injured or compressed by the extravasated juices; or if a wound of the head is followed with a loss of all the animal actions, we have then reason to fear that the brain itself is in like manner injured. If again we observe, after a wound has been inflicted on the back, that all the parts below the wound are deprived of sense and motion, we may then conclude the medulla spinalis to be injured; and the same may be said concerning the injured actions of other parts wounded.

3. If blood is discharged of a scarlet and frothy colour, either by spitting from the mouth, or from the orifice of a wound inflicted in the thorax, we then know that some of the pulmonary vessels are divided. But if after a wound of the abdomen any of
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the chyle is discharged from thence, it denotes that the small intestines are injured; but if any of the fæces come out, it is a sign that the large intestines are wounded; but if any blood comes away with the patient's urine, we then know that the kidneys, ureters, or bladder are injured, &c.

4. Exceeding great pain arising suddenly after a wound has been inflicted, denotes an injury either of the nerves or tendons, or else of the nervous and tendinous membranes; but a singultus and convulsions may arise from remote and different parts being injured. A hiccup and convulsions frequently arise from profuse hæmorrhages, and then they are dangerous, according to the opinion of Hippocrates in his aphorisms and prognostics. A hiccup arising from the Iliac passion is pronounced bad by Hippocrates, whence also it is very probable, that the same may arise from a wound in the intestines. Wounds of the diaphragm, œsophagus, stomach, and head, are all attended with a hiccup; whence it follows, that considering the hiccup as a sign, it only shows the malignity of the wound, but does not always indicate the particular part injured.

But tumours arising suddenly after a wound, either denote an extravasation and preternatural retention of the juices, or else signify that the air has penetrated through the wound, and is extraordinarily dilated by the heat of the body. We shall hereafter speak concerning those surprizing tumours formed in wounds of the thorax, by the penetration of the air into the cellular membrane, which is thereby distended surprizingly all over the body.

S E C T. CLXIX.

FROM a knowledge of the several particulars in 167 and 168, may be deduced a previous view of the event which will follow from the wound; such as

I. Whe-

1. Whether the wounded patient will live or die.
2. Whether the wound is curable or not, and in part, or wholly so.
3. Whether the cure will be easy, difficult, long or short,
4. What effects will remain after the wound is healed; whether a tabes, insensibility, immobility, deformity, &c.

After the diagnosis of a wound, which indicates the parts injured with their actions impeded or destroyed, has been reduced from the artifices at present known for that purpose, and from a due examination of every thing mentioned in the two preceding sections; the Surgeon may then be able to predict the events of the wound, and he will also be able to foresee all the consequences following from a wound as the cause. This part is therefore termed the prognosis of wounds, in framing which the utmost caution is always necessary. (b) *Est enim prudentis hominis, primum eum, qui servari non potest, non attingere, nec subire speciem ejus, ut occisi, quem sors ipsius interemit. Deinde, ubi gravis metus sine certa tamen desperatione est, judicare necessariis periclitantis, in difficili rem esse; ne, si victa ars malo fuerit, vel ignorasse, vel fefellisse videatur. Sed ut hæc prudenti viro conveniunt, sic rursus histrionis est, parvum rem attollere, quo plus præstitisse videatur.* “ A prudent Surgeon or Physician, will not undertake the cure of a case that is desperate, nor assert the injuries received by any one to be mortal, whose habit is the fatal cause. In the mean time, when he perceives the case very difficult and dangerous, without being absolutely desperate, he ought to give warning thereof, lest the bad events should be imputed either to his ignorance or misconduct, or to the insufficiency of the art. But as this is the proper conduct of prudent and regular artists,

(b) Celsus, Lib. V. cap. 26.

“ artists, on the contrary, it is the part of a quack to
 “ make a slight case appear dangerous, that his cure
 “ may seem the greater.”

But it is well worth observing, that there are frequently cases in which even the most expert anatomists may be deceived in their determining what parts are wounded; for the position of the internal viscera has frequently been observed very different in some people, from what they naturally and usually have. M. Meri found a very extraordinary perversion of the natural situation of the viscera, which were displaced so that the basis of the heart lay towards the left side of the thorax, and its apex toward the right side, while the large blood-vessels belonging to it were equally displaced. In the abdomen the stomach was so placed, that its pylorus, with the duodenum joining to it, lay in the left side; the liver at the same time was placed in the left hypochondrium, while the spleen occupied the right; the intestinum cæcum and beginning of the colon lay upon the left ilium, &c. (b) An example of the like kind was also observed by Drelincourt senior, in which the spleen and liver had changed places, the former lying on the right side, and the latter on the left (c).

But these transpositions of the viscera were in healthy people, and they were in that manner displaced even at their first formation; to which we may add, that diseases frequently change the natural situations of the viscera, as we are assured from the most certain observations. The position of the stomach especially has been observed to be surprizingly perverted, together with the other viscera of the abdomen, in the body of a woman after frequent vomitings. (d) And it seems very probable, that the viscera are thus even frequently displaced, since I have several times made the like observation in the subjects which
 I have

(b) Journal des Savans Janvier 1689. & Act. Lipf. 1690. p. 450.

(c) Caroli Drelincourt. opusc. pag. 721.

(d) Mem. Acad, 1716. pag. 238.

I have either dissected myself, or have seen dissected by others. I have seen the spleen prolapsed into the pelvis, the bottom of the stomach continued below the navel; and have also seen that part of the colon which lies under the stomach so reflected thence, as to form an arch below the navel, the convex part of which was towards the pelvis, and its concavity towards the stomach, &c.

But the errors which arise from this source in the prognosis of wounds seem to be unavoidable; for who could assert or foretel that the viscera were thus displac'd, or by what signs could any one discover the same?

Besides these, the particular habit or disposition of the wounded patient, may very much change the consequences or effects of the wound inflicted; for example, some are so timorous that they faint away at the sight of blood, even though it flows from the wound of another. Whence Hippocrates prudently observes, (a) *Multa vulnera in locis minime malis esse, & nullo modo gravia videri, sic tamen dolet plaga, ut respirare non possint: alii vero præ vulneris dolores, ubi nihil periculosi aderat, spiritum quidem duxerunt, verum delirarunt, & febricitantes mortui sunt. Quicunque enim aut corpus in febres pronum habent, vel mentes facile turbandas, talia patiuntur. Sed neque hæc admirare oportet, neque formidare, illud expendendo quod & animæ & corpora hominum plurimum differunt & vim maximam habent, &c.* “ That many wounds which are slight in
 “ appearance, and inflicted on parts seemingly of
 “ little moment, are notwithstanding so painful that
 “ the patient cannot breathe: and others again have
 “ indeed been able to fetch their breath in wounds
 “ seemingly without danger, and yet by the violence
 “ of the pain they have been thrown into a fever and
 “ delirium, issuing in death: and especially those suf-
 “ fer in this manner, whose habits of body easily
 “ dispose them to fever and delirium. But we
 “ ought neither to be surprized nor affrighted at con-
 “ sidering

(a) *Prorrheticorum*, Lib. II, Chapter. Tom. VIII. pag. 817.

“ fidering this, fince the mind and body are very different, and operate very powerfully.”

Under thefe cautions therefore ought the prognosis of a wound to be formed, in which we enquire,
1. Whether the wound inflicted is fuch, as that it will from its own nature infer death, not to be avoided by any art, or whether the patient can furvive after the wound.

2. A wound is faid to be healed, when its parts which were divided from their natural union are again conjoined or united together; for example, if the finger is fo cut tranfverfely, that it only adheres by a bit of fkin, a Surgeon cannot promife the cure of fuch a wound; he may indeed fave the patient, but it muft be with a lofs of this part of his body. It alfo frequently happens, that after the wound is cured, all the parts injured are not reftored to their former ufes which they had in health, and then the cure is not compleat but in part only; for example, if a large nerve be totally divided, the cure of fuch a wound will be never perfect, but all the actions of the wounded parts which refulted from the nerve entire will remain afterwards deftroyed.

3. For unlefs this be told foon after the infliction of the wound, the difficulty or length of the cure will be imputed as a fault in the Phyfician or Surgeon. A wound is faid to be eafily curable which does not much diforder the patient, and which does not require any great art or attendance of the Surgeon to perform it; for example, when the tendon of the extenfor mufcle of the thumb is divided and contracted under the integuments, that wound cannot be healed, nor the part reftored to its former and natural ufe, unlefs by dilating the wound the end of the divided tendon be taken hold of and drawn down with a pair of plyers, fo as that it may be fewed together with the other end, but this cannot be performed without pain and difficulty; and though prudence fometimes requires that the Surgeon fhould not reveal this to the patient,

patient, yet he ought to acquaint his friends before-hand, lest the tediousness of the cure should be afterwards imputed by either of them to the Physician or Surgeon. When the wound inflicted is attended with any considerable loss of substance, as when a sword has cut off a large piece of the skin and membrana adiposa, there is then required a considerable time to incarn or restore the lost substance; but if the wound is no more than a simple division of the skin and fat, it may then be speedily consolidated or healed in a short time, provided the lips are first well closed according to the rules prescribed; and supposing the patient to be of a good habit of body, otherwise, if he be cacochymical, or his juices in an ill state, the cure will go on much more slowly, and will be more difficultly compleated. All this ought to be told in the prognosis of a wound, because many people are otherwise inclined to think that the Surgeon prolongs the cure designedly to increase his profit, which we may readily believe will be the farthest of any thing from the thought of an honest man.

4. The Surgeon ought carefully to regard this; because in wounds which are not mortal, the judge usually inflicts a punishment or penalty proportionable to the damage the patient sustains from the wound. And for the same reason, the counsel for the defendant generally use all the art they are masters of, to throw most of the ill consequences or bad effects of the wound, upon the neglect or mismanagement of the Physician or Surgeon; and therefore the ill effects which will follow the wound, tho' ever so skilfully treated, ought to be declared at the first dressing, and deduced partly from a knowledge of the anatomy of the parts wounded, and partly from the functions injured by the wound; or if the consequent effects cannot be precisely told, the Surgeon ought at least to pronounce that there is danger of such and such accidents remaining after the cure of the wound. There is no case in which a Surgeon is treated with more injustice than

than in wounds; for if the part loses its motion after the wound is cured, they plead the person who has treated the wound, and not the party who inflicted the same; whereby the disgrace and greatest part of the crime is cast upon the Surgeon instead of the offender. If a part be therefore supplied with but one artery, and that is totally divided in a wound, we may then pronounce that the part will be consumed or withered after the cure; if a large nerve, which furnishes the part with its small branches, be totally divided or destroyed in a wound, we may then presage the loss of sense and motion in the part, &c. or, lastly, if the wound cannot be healed without a tedious and profuse suppuration, (as when parts of an injured bone are to be brought away) which destroys the *membrana adiposa*, we may then predict that a large and unsightly scar will remain after the cure.

S E C T. CLXX.

DEATH follows inevitably in wounds from five causes, and therefore such wounds (151) are absolutely and necessarily mortal, as follow.

This paragraph points at those wounds which by an inevitable necessity prove fatal, notwithstanding all the art and assistance hitherto known, so as to kill the patient, *i. e.* destroy the condition of body which is absolutely necessary to maintain its commerce with the mind to a certain degree, so that it cannot be restored; for death does not require a total abolition thereof (*a*): but it is apparent from physiology, that this commerce of the body and mind absolutely require the continuance of the muscular action of the heart, receiving the blood into its ventricles, and protruding the same into the arteries. Hence the first number following contains such wounds as destroy the influx of nervous juice

(*a*) Vide Instit. Sect. 42.

juice necessary to the muscular motion of the heart; the 2d number comprises those wounds which penetrating the auricles or ventricles of the heart; prevent it from containing the blood; and in the 3d number we meet with those wounds which injure the larger vessels, so that they let out the blood, and prevent it from returning to the heart. But as the blood cannot pass from the left ventricle of the heart, but through the lungs, except in a fœtus, therefore it is necessary for the lungs to be dilated by respiration before the right ventricle can contract; so that the 4th number contains those wounds which totally destroy respiration; lastly, as life and health necessarily depend on the solids and fluids which are daily consumed, life therefore requires a constant supply of those many and various juices, which are exhausted in the continual actions of the body: but all the juices now mentioned are formed from the aliments by the natural actions, converting their substance into the solid and fluid parts of our bodies (§. 1.); and therefore, in the 5th place, are reckoned those wounds which destroy the integrity of the parts absolutely necessary to these functions.

And to these five heads may be reduced all wounds which are absolutely mortal, as,

1. Those wounds which intercept the influx of the nervous juice from the cerebellum to the heart; and these are, 1. Those which penetrate deep into and greatly injure the brain, cerebellum, or medulla oblongata. 2. Such a rupture or division of the blood-vessels within the cranium, with an extravasation of their contents as may destroy life by compression, or exciting a putrefaction, and which cannot be relieved by the trepan, from the condition or structure of the cranium, as when the part affected is below the orbits of the eyes, or else beneath the ossa

temporalia, the os ethmoides, or basis of the cranium, &c. 3. Wounds which penetrate deep in the upper part of the spinal medulla; and lastly, 4. Those wounds which divide the cardiac nerves.

1. Since the heart is a muscle, its action requireth the presence of those causes which are necessary for moving all the other muscles of the body, which we know by certain experiments cannot move without an influx of spirits by the nerves, necessary to the actions of the muscle; and therefore the same holds true also in the heart. It is also evident from the daily observation of Physicians, that when blood is extravasated within the cranium by some external violence, so as to compress the whole substance of the brain, all sensation and voluntary motion depending on the will, are thence perfectly destroyed; but at the same time, at least at the beginning of the disorder, the action of the heart rather increases, as we know from the strength and frequency of the pulse in apoplexies; to account for which, we know from anatomy, that the cerebellum is most safely secured under the cerebrum, and being covered with an expansion or process of the dura mater, it cannot be so easily compressed by the extravasated humours as the brain itself; but when the same causes increasing or continuing to begin to compress the cerebellum itself, then the action of the heart is destroyed and life ceases, notwithstanding the structure of the cerebellum is somewhat firmer than that of the brain, whereby it is enabled more strongly to resist the compression. From hence we know, that the cerebellum supplies the spirits required by the nerves for the muscular motion of the heart, and therefore wounds which greatly injure the cerebellum, or totally destroy its action, are here justly considered as mortal.

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What we have before advanced is confirmed by experiments on living animals. The brain of a large dog was cut away in slices during almost the space of whole hour, but the very moment that the cerebellum was injured he instantly expired (*b*). “ While the cranium of another dog was opened above, the cerebellum was no sooner divided and taken out of the skull, but he was instantly dead, notwithstanding the crura of the brain and medulla oblongata was not at all injured (*c*). ” And Bohnius (*d*) having thrust knife into the cerebellum thro’ the sagittal future in young whelps, in which the skull is soft and the future open, he observed that they expired with a slight convulsion of the external parts; and after opening the cranium, he found that in one the instrument had penetrated almost through the whole mass of the cerebellum, and that in the other it had penetrated only to the nucleus of its medulla.

Nor is it any objection to the mortality of wounds in the cerebellum, that Webfer (*e*) observed in young whelps lately pupped, that the motion of the heart continued alternately, with a dilatation and contraction, for several hours after the head was cut off; for we are here treating not of that wonderful property in the heart, whereby it continues to move a long time after it is taken out of the body, but concerning the duration of life (as at § 1.); for the Physician before mentioned hardly intended to deduce consequences from these experiments repugnant to former observations, as he himself testifies.

But as it appears from anatomy, that no nerves are derived from the cerebellum immediately, but that the whole medullary substance therefore converges and enters into the medulla oblongata, from whence the nerves afterwards arise, it is therefore sufficiently evident,

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(*b*) Perrault *Mechanique des Animaux*, Part. II. chap. 7. pag. 403.
 (*c*) Vieussens *Neurograph*, univers. Lib. II. cap. 20, pag. 123.
 (*d*) De Renunciacione vulnerum, &c, pag. 169. (*e*) *Cicutæ aquæ Historiæ & noxæ*, pag. 91.

dent, that wounds considerably injuring the medulla oblongata, will be followed with certain death. If again it be considered at the same time, that the cerebellum and medulla oblongata are so artfully secured, that they cannot be wounded without greatly injuring the brain itself, with the large blood-vessels and muscles, &c. this will be a strong argument for the mortality of such wounds.

But for wounds in the brain itself, though they are large they are not always fatal, as we are assured from many observations, of which we shall speak in treating of wounds in the head.

2. When any of the larger arteries or veins are divided by any cause, they discharge not only their contained blood, but also that which was continually propelled by the force of the heart through those vessels when entire; but the bones of the cranium are too hard to yield, and their whole cavity is very exactly filled with the encephalon in a natural state, and therefore any blood extravasated here, must necessarily compress all the parts contained in the cranium; hence the actions of the brain begin to vanish immediately after the juices are extravasated within the cranium, and in a little time, by the increase or continuance of the same cause, the cerebellum and medulla oblongata are compressed so, that the life thence resulting is destroyed. But if the extravasated blood was not so much, as by its pressure to destroy the action of the brain, cerebellum, and medulla oblongata, it may notwithstanding prove injurious otherwise; for the extravasated juices of a human body naturally degenerate by putrefaction, and though they corrupt more slowly in parts where there is no free access of the air, yet they degenerate thus in time, and becoming acrid, they corrode, inflame, suppurate, and destroy the tender substance of the encephalon; from whence it is we are furnished with so many observations, proving, that wounds and contusions of the head, seemingly slight or of no moment, have, after a considerable time, brought on sudden

den death. In opening these bodies, a large quantity of ichorous, and purulent matter has been observed in the cranium, and frequently the encephalon has been thereby greatly consumed, of which instances may be seen in Bonetus (f).

The chief hopes then in these cases are placed in trepanning the cranium, and giving a free exit to the extravasated juices; but if the wounded part is of that nature, that it will not admit of the trepan, death must follow inevitably; and those parts of the cranium which admit not of the operation are the following.

The bottom of the orbits of the eyes] That part of the orbit is here intended which constitutes a great part of the basis of the cranium, and which is inferior with respect to the cranium, but composes the upper part of the orbit, which is a lamella, or production of the os frontis, and in some places so thin that you may see through it in dried skulls, where it is hardly ever thicker than one's nail; but these lamellæ, upon which the anterior lobes of the brain are seated with their large blood-vessels, being thus thin and weak, are easily perforated; whence the blood extravasated will be lodged under the brain upon the basis of the cranium, so that it cannot be discharged by the trepan, whence the danger of wounds inflicted in this part is very apparent. A man was wounded with the end of a stick, which was not very sharp, in the left orbit of the eye; the wound indeed seemed to be slight, or of small moment in the eyes of those who were employed to cure it, but notwithstanding the patient died of it in a little time; and when the cause of his death was searched after by publick authority, after dividing the cranium with a saw, there appeared a deep wound, penetrating into the brain itself (g).

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(f) Boneti Sepulchret. Tom. III. p. 318, & seq.

(g) Ruysschii Obs. Anat. 54.

Offa temporalia.] Those cavities which appear in dried skulls, to be formed by the vibration of the arteries of the dura mater, demonstrate how considerable are the arteries which run upon the temples, which being injured or wounded discharge the blood down towards the basis of the cranium; to which if we add the vast temporal muscles here placed, there is no possibility of applying the trepan to any part here, and therefore all those accidents are to be feared, which one may expect from the pressure or putrefaction of the extravasated juices.

Os ethmoides.] This may perhaps seem at first to be placed so securely that it cannot be easily injur'd; but if the hilt of the sword be inclined backward, while the point of it is thrust upwards in the nose, it may easily perforate this bone; and also if a wound be inflicted in the lateral part of the eye towards the nose, it may easily perforate that thin lamella or process of the *os ethmoides*, which constitutes part of the orbit, and is termed the *os planum*, and in that case the wound will penetrate into the cavity of the cranium. An observation of this kind we have in Bonetus (*h*), who tells us, that a student in the law was punctured with a sword below the left orbit, and after the space of twenty-four hours, he died apoplectic; upon opening the cranium the wound appeared to penetrate through the orbit of the eye, and thro' the *os ethmoides*, near the *processus crista galli*, into the right ventricle of the brain, and in the basis of the cerebrum and cerebellum was found a large quantity of extravasated blood, whence it is very evident that this case would not admit of any relief.

Lastly, all those other wounds which penetrate the basis of the cranium, are for the same reasons followed with inevitable death as the consequence.

3: After the *medulla oblongata* has sent out the nine pair of nerves within the cranium, all the rest of the brain and cerebellum is collected together into one trunk

trunk or bundle, which descending securely through the bony case of the vertebræ, is continued down to the os sacrum. It is from this spinal medulla that all the limbs, and many of the viscera below the head, are principally supplied with nerves: if therefore the spinal medulla is wounded pretty deeply in its upper part, its soft substance will be destroyed, and the action of the brain and cerebellum will be abolished from the parts below, at least so far as they were dependent on the continuity of the medullary fibres wounded; for the ninth pair of nerves, called the par vagum, with the intercostal nerve, arise much higher from the medulla oblongata within the cranium, and their branches go to most of the vital viscera. Hence then a person does not die hastily after such a wound, though he will inevitably perish sooner or later, according as the medulla was more deeply wounded, or in a higher part; the reason of which is evident, for the whole mass of the brain and cerebellum separate by their structure from the arterial blood, that very subtiler liquor which is afterwards continually sent to all parts of the body by the medullary fibres of the encephalon continued through the nerves; so that if the quantity of blood brought to the secretory organ remained the same, then the number only of the canals, which ought to contain and carry the secreted liquor to the respective parts, will be disturbed, and at length destroy the actions of the secretory organ itself; but it generally happens, that large blood-vessels are injured at the same time that the spinal medulla is wounded, whence the extravasated juices, having first filled the cavity of the vertebræ, easily re-ascend afterwards into the cavity of the cranium. The mortality of these wounds is sufficiently apparent from their events, recorded by the writers of observations.

A countryman fell out of a tree and luxated the second vertebra of his neck next the atlas, as appeared afterwards by dissection; however, he lived in this manner for many days afterwards before he died.

Others again expire in a very short time after the like accident (i).

Sennertus says (k), *se novisse lanium quemdam, qui boves maculaturus, eos non securi, quod vulgo fieri solit, percutiebat, sed exiguum cultellum eo in loco, quo caput vertebri colli conjungitur, in spinalem medullam adigebat; unde bos attonitus quasi statim concidebat*: “ He knew a
 “ butcher who used to kill his oxen, not by knocking
 “ them down in the common method, but by thrust-
 “ ing a small knife into the spinal medulla, in that
 “ part where the head is connected to the vertebræ of
 “ the neck, whereupon the ox immediately fell down
 “ dead.” The same thing is also remarked long before by Galen, who observes, that the oxen which were daily killed by dividing the spinal medulla at its origin near the first vertebra of the neck, fell down instantly, the respiration and voice ceasing at the same time that the wound was inflicted.

The like experiment has been repeated with the same success upon young dogs.

Even Hippocrates (l) himself has pronounced wounds of the spinal medulla to be mortal; and in one place he says (m), *Medulla spinæ si ægrotaverit, sive ex lapsu, sive ex alia aliqua causa, sive sponte; homo & cruribus impotens fit, ut neque, si tangatur, percipiat, neque ventre aut vesica circa prima tempora stercus vel urinam egerat, nisi coactus. Quum autem vetustior factus fuerit morbus, non urgente homine & stercus prodit, & urina. Moritur autem post hæc non multo tempore interposito*: “ If
 “ the spinal medulla be injured, either naturally or by
 “ a fall, or any other accident, the patient, and espe-
 “ cially his lower limbs, becomes paralytic, and loses
 “ the sense of feeling; nor are the fæces either of
 “ the intestines or bladder duly discharged by the ab-
 “ domen, in the beginning of the disorder, unless
 “ excited:

(i) Bonet. Sepulchret. sive Anatom. pract. Tom. III. pag. 427.

(k) Tom. III. Lib. V. part. 4. cap. 3. pag. 371. Galen de Hip. & Platon. placitis, Lib. II. cap. 4. in fine. Charter. Tom. V. pag. 97.

(l) De morbis, Lib. I. Charter. Tom. VII. pag. 532.

(m) Prorrhetic. Lib. II. cap. 11. Charter. Tom. VIII. pag. 819.

“ excited: but when the disease is grown older, the
 “ urine and fæces come away involuntarily from the
 “ patient, who does not survive long after the ap-
 “ pearance of this symptom.” But it is evident, that
 in this place he treats of the medulla spinalis being
 injured in its lower part, notwithstanding he presages
 death from thence. And that wounds there inflicted are
 highly dangerous, may appear from the two instances
 mentioned at the end of §. 162. but that those who
 escape do at best lead a miserable life, though some-
 times pretty long, may appear from the two instances
 given us by Hildanus (*n*), where by a luxation of the
 vertebræ at the loins, the spinal medulla was com-
 pressed. In one case there was an abscess formed
 which left a fistulous ulcer, though most of the symp-
 toms abated, so that the patient could retain both
 the urine and fæces; but at the same time was de-
 prived of all sense and motion in the parts below the
 navel, surviving in that condition for some years: but
 in what manner death at last came on, Hildanus af-
 firms himself ignorant. In the other case, the second
 vertebra of the loins was thrust inward with a palsy
 of the lower limbs, as also of the sphincter ani and
 vesicæ. The patient being young, and of a good
 habit, our author tells us, that he recovered the sense,
 and some degree of motion in the parts affected; but
 he takes no farther notice concerning the event of
 the case.

But as for any considerable wound or injury inflicted
 on the spinal medulla in its upper part, I know not
 that we are furnished with any histories or observations
 of such.

4. For by the cardiac nerves is conveyed that very
 subtle fluid, which being separated from the arterial
 blood by the structure of the cerebellum, is absolutely
 necessary for the muscular motion of the heart.

The heart is sustained at liberty in the pericardium,
 without adhering to any part but the vessels, which
 either

(*n*) Observat. Chirurg. cent. V. pag. 458, 459.

either enter into, or come out from it; all which vessels to which the heart is attached, are set at liberty for motion, without adhering to other bodies. The nerves therefore which enter the substance of the heart, must necessarily enter it together with the blood vessels, which are the only support of the heart in its pericardium. Hence the nerves belonging to the heart are not every way at liberty, as people might imagine from the figures of anatomists; but they are attached to the veins and arteries which convey the blood to and from the heart, from which admirable position of the cardiac nerves it is, that the systole and diastole of that muscle may be understood and accounted for, as may be seen in the Institutes of our professor Boërhaave; for the same cause, which one moment produces the motion of the heart, does by the mechanism of these parts destroy the same motion the moment after; so that one instant of life the heart will be contracted suddenly and strongly, as it were with a convulsive motion, and the instant after it will be perfectly relaxed or paralytic.

Hence it is evident, that the cardiac nerves cannot be divided near the heart, without wounding the adjacent large vessels at the same time, and then death becomes inevitable from the wound of these vessels. But we are here only to consider wounds or injuries of the cardiac nerves. We know from anatomical observations, that all the nerves which ascend to the heart, arise from the eighth pair, with the intercostal and recurrent nerves: but the trunks of these nerves may be wounded in their progress, so as to destroy the action of those branches which pass from them to the heart.

Dr. Willis (o) having made an incision in the skin of the neck of a live dog near the windpipe, applied a strict ligature upon the trunks of both the nerves of the par vagum on each side, after which the animal presently became stupid and dumb, with a considerable

(o) Cerebri Anat. p. 324.

ble trembling and convulsive motion about the hypochondria. These symptoms disappearing a little while after, the dog flung himself down as if he was about to expire, and refused to take any aliment: however, he lived many days afterwards, notwithstanding those nerves were totally divided, 'till at length he was destroyed chiefly with hunger. Upon opening the body of this animal, the blood was found very grumous and concreted in the large blood-vessels, and in the ventricles of the heart; but no such coagulation of the blood is observed in animals which die with hunger: and the reason why the dog lived so long after the experiment, is by Dr. Willis himself attributed to the small branches of the recurrent and intercostal nerves detached to the heart.

This same experiment was also performed by Lower (*p*), who observed, that the heart instantly after trembled and palpitated, in which manner the animal continued living a day or two in a miserable condition, languishing with palpitations of the heart, sighing, &c. 'till he at length expired; in short, the animal suffered so much anguish, that he could not be confined without binding him with the strongest ligatures. Whereas Bohnius (*q*) affirms, that the animal thus philosophically martyred does instantly expire, from the ligatures on these nerves, as if he were thunder-struck. The nerves of the eighth pair, with those of the intercostal, being transversely divided near the neck, the animal instantly languishes, trembles, and faints, which are the forerunning symptoms of death, following in about twenty hours after (*r*). Having myself made the same experiment on a dog, by tying the intercostal nerves, and those of the eighth pair on each side the neck, the animal did not any longer howl; and though he endeavoured with all his force to cry out, he only made a little obscure noise; at some intervals

(*p*) Lownerus de corde, pag. 90, 91.

(*q*) Johan. Bohnii circulus Anatomico-Physiologicus, &c. pag. 96,

(*r*) Vieussens Neurographia, pag. 179.

intervals of time he would put himself into a great rage, and express violent anguish, biting every thing in his reach with the utmost fury ; but before he went into a fit of this kind, he would first draw up his nose in a surprizing manner. In this condition he lived from six o'clock 'till eleven in the same evening, and the next morning he was found dead.

From all these experiments it is evident, that a division of the cardiac nerves is sooner or later followed with the death of the animal, who instantly after the operation falls into anguish or agonies like those of death, arising from the heart's being no longer able to discharge its contained blood. But we sometimes observe in diseases, that a patient will continue above two days in such agonies, from the blood not being able to pass through the obstructed arteries. And the same thing seems to happen in the above-mentioned animals, who lived longer after these nerves were tied or divided. But there may possibly be other small nerves, which being distributed through the substance of the heart, enable it to continue moving so long after the experiment ; accordingly, a pretty considerable branch of a nerve has been observed arising from the semilunar and gangliform plexus of Vieussens, near the great mesenteric plexus ; from whence ascending out of the abdomen into the thorax, it is inserted about the basis, and right auricle of the heart (s). It may be also questioned, whether that surprizing and innate propensity of the heart, to contract even after it has been cut out of the body, may not in this case conduce towards the continuance of its motion, so as to keep the animal alive, even though the cardiac nerves are destroyed ? but concerning this we spoke before, §. 1.

Thus we see by experiments what happens to brutes, after dividing the cardiac nerves ; but it very seldom happens that the trunks of the eighth pair and intercostal nerves are wounded in men, without a division of

(s) Acad. des Sciences l'an. 1734. Hist. pag. 60.

of the large blood-vessels at the same time, which last is of itself sufficient to infer death: for the trunks of the carotid arteries and large jugular veins are incumbent on these nerves in the neck, and lie behind the lateral processes of the vertebræ of the neck, which secure them from injury; so that I do not remember to have read one instance of the cardiac nerves being wounded alone, among any of the writers of observations in physic or surgery.

2. Those wounds which penetrating the cavities of the heart let out its contained blood, whence all deep wounds of the heart entering its auricles or ventricles are mortal.

Since the heart is a muscle continually in motion, to which all the parts of the body are so related and united, that one cannot subsist without the other, it has been therefore termed the fountain of life by many of the antient Greek and Arabian Physicians, who have also pronounced wounds of the heart to be certainly and speedily mortal; but they seem to have said this rather from hypothesis, than from real facts or experiments.

We have some wonderful accounts and instances given us by authors, which if they were true, would prove that animals might live without a heart. Cæsar the dictator, the first day of his procession, being cloathed in his scarlet gown, and seated on his chair of state, sacrificing, observed the heart to be twice wanting among the intrails (*t*); reflecting upon this deficiency, he considered it as a bad omen, as being naturally inconsistent with an animal to be without a heart, as Plutarch tells us (*u*); and the same relation we have in Cæsar's life by Suetonius (*w*). But the augurs often impudently impose upon the credulous, to make them believe, agreeable to their sinister views; and

(*t*) C. Plinii Secundi Lib. XI. cap. 37. pag. 248.

(*u*) In vita Cæsaris, pag. 737.

(*w*) Cap. 77.

and therefore the truth of this relation is much suspected, since it is so absolutely repugnant to the known œconomy of animals.

It is hardly credible, that the heart was ever wanting either in man or any other animal; but a careless person might be deceived from the situation, figure, magnitude, &c. of the heart, being considerably altered in diseases; as we are informed in the writers of medical observations.

But there was an account sent to our celebrated professor Boërhaave twenty-three years ago, from an eminent anatomist at Edinburgh, relating an observation, demonstrating, that there are some monsters in nature which confound all our knowledge as to the use of the parts. This anatomist was searching for the seminal vessels in a large live rat, and he found the right kidney double in appearance, and after opening the investing capsule, the right kidney appeared distinct; but that body which resembled a kidney included in its proper sacculus, was of the usual size and figure of the heart in this animal, being placed with its basis upward, and its apex downward. This heart being strictly examined, appeared to have two ventricles divided by a septum, and furnished with a left auricle; it had also the valves and columnæ carneæ of the heart: but it had no appearance of a right auricle, nor any vena cava; nor had it any pulmonary vein, nor any aorta. Upon opening the thorax, there was neither heart or pericardium to be found; but there was the right auricle of it to be seen, emerging from the vertebræ of the thorax, betwixt the lobes of the two lungs; and from hence arose the pulmonary arteries. The vessels for conveying the blood from the lungs were united into one trunk, which was the aorta; afterwards distributing itself in the usual manner. This animal was an adult, and had all the other viscera well formed; and though it had a heart, it was preternatural and useless, though furnished with the usual parts;

parts; whence it is inferred, that an animal may live and thrive without a heart.

We are already furnished with many faithful observations which testify, that several animals live some time after the heart has been cut out; even animals have breathed and cried out, nay even fled from the altar in sacrificing, after the heart has been extracted, and this even 'till they have expired with loss of blood.

(x) The thorax of some animals being opened alive, and a ligature made about the basis of the heart, so as to constrict or intercept all its vessels; if then the whole heart be expeditiously cut off, and the animal set at liberty, it will even run to some distance; as Vesalius has observed (y) in some dogs, but especially in cats. Also the heart being cut out of whelps lately taken from the uterus of a living bitch, they have lived for the space of a quarter of an hour afterwards, exhibiting a sensible motion of their limbs with a sort of a murmuring noise. It is also evident from the history of animals, that many of them, and especially reptiles, or those of the worm kind, will live a long time after the heart has been cut out; and what is more, even the pieces of those animals into which they are divided, continue to move for a considerable time. But we know from the observations of Malpighi and Lewenhoeck, that the life of animals, during their first formation, resembles that of a worm; and therefore, perhaps, animals in utero may be more retentive of life on that account. A frog has leaped about after its heart has been cut out, and upon throwing it into water it has swam; even after this it has very nimbly jumped out of the vessel of water, and continued to hop about the room for above an hour (z).

The heart of a living man being cut out by the executioner, the criminal has been heard to utter three or four words, while his heart has been in the hand of the

(x) Galen de Hippoc. & Platon. placitis, Lib. II. cap. 4. in fine. Charter. Tom. V. pag. 97. (y) Vesal. pag. 570. (z) Boyle de utilitate Philosophiæ Experimentalis, pag. 113.

the extractor; but then the great man (a) who tells us this, also informs us, that the friends of the criminal had given a reward to the executioner to perform his office as nimbiy as possible, to put the man out of his misery: and therefore it will not appear so wonderful, that (while the divided vessels were contracted by the cold air, with which they had never any communication before) the person should in his last moments of life continue to utter some words for a short space, if we also consider all the animal organs were then entire and in a sort of intense struggle; from both which causes the blood might be pressed forward to the brain for a few minutes; especially if we also consider, that the lungs, upon opening the thorax, expel their contained air with a considerable force, as well by their own natural contraction, as by that derived from the pressure and cold of the ambient air. This experiment is not therefore repugnant to the necessity of the heart in animals: and even in the experiment of Vesalius, by making a ligature on all its vessels, the contracting arteries having their elasticity increased by the admission of cold, might continue to propel their blood for some time through the brain and cerebellum, so as to continue life some time after the experiment.

But as for those experiments made on frogs, vipers, tortoises, and many such like animals, demonstrating that they can live a long time after their heart has been extracted, those only show that the mode of life in animals cannot be limited by general rules, since it is different in various animals; so that we cannot easily lay down a general history of life, which we can only remark by experiments.

But we are not furnished with any certain observations, proving that the heart was ever wanting in man, nor that he could ever survive any considerable time after the total destruction of that organ; whence it is sufficiently evident, why wounds of the heart are justly esteemed and considered as mortal. But yet all wounds

(a) Verulam. *Histor. vitæ & mortis*, pag. 559.

wounds of the heart are not mortal, since they are very different, according to the several parts of the heart in which they are inflicted.

Thus, for example, if a wound divides the trunk of the coronary artery, or vein, in the basis of the heart, speedy death seems to be the inevitable consequence; because the blood is very forcibly impelled by the contraction of the aorta into the coronary arteries, and by them through the muscular substance of the heart, and very swiftly returned into the veins: for the whole heart is pale at each contraction, all its blood being expressed the moment after its systole; but during its diastole, all the vessels belonging to the whole substance of the heart are filled.

But if the wound penetrates into the cavity of the right ventricle of the heart, the blood will run out partly from the divided vessels of the heart, and partly from the cavity of its ventricle into the pericardium, and from thence into the cavity of the thorax, or else be discharged by the wound externally. Such a wound too will enlarge while the heart is filled, and when that organ is contracted, the parts of the wound will rather be brought close to each other, so that during the time of this last, there will not be much blood shed. In the mean time, the *vis vitæ* will be weakened by the loss of blood, though life and the action of the heart still continue; but this last is very languid and slow in its action, when the weakness is very considerable; and if at the same time there be no motion in the muscles, the venal blood will return very slowly into the heart. If now in this case there be no stimulus used to excite the circulation, especially those included under the title of cordials, which ought carefully to be avoided; I say, in this case, the life of the patient may possibly be preserved, and the wound healed. For nobody would believe with how small a quantity and motion of the blood a person may live, who is not acquainted with the instances given us by practical writers in the case of wounds,

and in the miscarriages of women: for by such a profuse hæmorrhage the quantity and impetus of the blood being greatly diminished, the wound is hardly any longer dilated, but the rudiments of an incipient concretion begin to be formed, and is by degrees perfected, if care be taken not to undo the consolidation of the parts lately begun, by augmenting the motion and quantity of the blood.

It is also to be remarked in wounds of the right ventricle of the heart, that the lungs continue to act, and by their dilatation give an easy passage to the blood to enter into them from that ventricle; hence therefore there will not be so much blood expelled by the wound during the systole of the heart, because of the free passage which it meets with into the lungs, whence again such a wound will have the greater opportunity to unite and heal.

But wounds of the left ventricle of the heart seem to be much more dangerous; since if it be not totally perforated, the wound will of necessity be continually lacerating or enlarging by the very strong power with which the left ventricle contracts; and which greatly exceeds the force of the right ventricle, in order to protrude its contained blood into the strongly resisting aorta, so as to dilate the same, and all its branches, throughout the whole body. For the fibres of the left ventricle will be drawn asunder in this action of discharging the blood, whence the wound will be again increased, 'till it penetrates into the cavity of the ventricle, and affords an easier exit to the blood that way, than through the resisting aorta; or even at best, if a wound of this ventricle begins to heal, there is great danger lest the part wounded should be extended into an aneurismatic tumour, so as to disturb the action of the heart, whereby life would be prolonged indeed; but not without the greatest anguish, which death only can remove.

But if the left ventricle of the heart be perforated with a large wound, speedy death must inevitably follow.

low. But of all wounds, none seem to be more expeditiously fatal, than that which divides the aorta immediately above the valves, at its origin from the heart; for when the left ventricle is perforated, the valves of the aorta continue shut, and resisting against the blood contained in the arteries; whence the whole arterial system continues full, and the arteries by their contraction continue the motion of the blood, whence life will be preserved for some time.

We have many observations which show, that men have often lived a considerable time after wounds of the heart, especially when the right ventricle only has been entered. Even some observations teach us, that wounds of the heart are curable.

A young man stabbed his friend with a knife, betwixt the third and fourth rib, on the left side; the wounded person walked home, upon his feet, from the out-parts of the city, and lived five days after. Upon opening his body, a wound appeared to penetrate the right ventricle in the heart, under the sternum, with a small and oblique aperture (b).

A student at Ingolstadt being stabbed in the left side by a printer, ran afterwards a considerable space through a long street; his mind and senses also continued entire for almost an hour after, so that he could speak or pray, and offer himself to God. Upon opening the body, all the Physicians and other spectators observed a wound penetrating transversely through the muscular substance, and through both ventricles of the heart, insomuch that they were able from the shape of the wound, to tell with what kind of weapon it was inflicted (c).

A certain nobleman received a wound in single combat from a sword under his left breast, and continuing to fight after the wound received, pursued his antagonist above two hundred steps, and then fell down dead. His wound was observed afterwards to have

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(b) Thom. Barthol. Hist. Anatom. rarior. Cent. 1. Hist. 77.

(c) Schenckii Observat. Medic. rariores, pag. 275.

penetrated into the substance of the heart, large enough to receive one's finger, and a large quantity of blood was extravasated upon the diaphragm (*d*).

The king of Denmark having shot a stag in hunting, it ran above five hundred strides before it dropt, after the wound received: but when the huntsmen came to embowel it, his chief Physician being present, found that the ball had passed through both ventricles of the heart, having made a wound large enough to receive the ends of one's three fingers (*e*).

In dissecting a man who had been formerly wounded in the thorax, the Surgeon observed a cicatrix of the inflicted wound in the cone of the heart (*f*).

Also in bears, dogs, and stags that have been killed in hunting, and in domestick animals, there have been observed the scars of old wounds in the heart, and even bullets that have remained there a considerable time. Many of these observations have been found together in *Miscellan. Cur.* (*g*)

From all which we may conclude, that wounds of the heart are always dangerous, but not always speedily or certainly fatal. It is also from hence evident, that we ought not to despair even in the most dangerous wounds; for while the patient continues only in a very weak and languid state, we see that wounds may be healed, which no one would have thought possible.

3. These wounds which derive the blood from the heart, brain, and cerebellum, by discharging it out of the body, or into some of its cavities, and which are incapable of relief from their place or situation: such as large wounds of the lungs, liver, spleen, kidneys, pancreas, mesentery,

(*d*) Pareus, Lib. X. cap. 32.
Anatom. rarior. Cent. I Hist. 77.

(*e*) Thom. Barthol. Hist.

1705. pag. 287. ex Celeberrimi Chirurgi Wolffii observatione posthuma, 21.

(*f*) Aët. Lipsiens. An.

(*g*) Decur. 2. An. 6. pag. 166, &c.

sentery, stomach, and intestines; of the uterus in pregnant women; of the bladder near its larger arteries; of the aorta, carotid, vertebral, and other such large arteries or veins.

We before showed in the preceding numbers of this section, that those wounds were mortal which destroyed the structure of the cerebellum, or injured the medulla oblongata, the upper part of the medulla spinalis, or the cardiac nerves themselves, whereby the necessary influx of nervous fluid, separated from the arterial blood of the cerebellum, is prevented from passing thence to the heart, and parts adjacent, for the performance of the vital functions. But for the separation of that fluid or vital spirits in the cerebellum, it is required that the blood be impelled through the arteries by the muscular force of the heart; whence also deep wounds penetrating the auricles and ventricles of the heart, are likewise esteemed mortal. But the whole action of the heart consists in receiving the blood from the veins, and in propelling the same into the arteries; whence it follows, that all wounds which injure those large vessels returning the blood to the heart, or conveying it from thence, so as to prevent the blood's circulation by extravasating the same, or accumulating it in the cavities of the body to such a degree, as to prevent the blood from passing through the arteries of the encephalon in its due quantity and motion; these wounds are also mortal, since they necessarily pervert, and at length destroy all the functions of the brain and cerebellum. Nor does it much matter whether the vessels be injured in their progress, before they enter the viscera, whose substance they compose; or whether they be injured in the viscera themselves to such a degree, as to produce the same effects, *viz.* a considerable extravasation of the vital blood sufficient to hurt the action of the heart and cerebellum. Therefore not all wounds of the viscera and vessels here enumerated in the last paragraph are absolutely

lutely mortal, but under this limitation. Besides this, to render a wound mortal, it is required to be out of the reach of ligatures, or other artifices, to prevent the hæmorrhage; and of this nature are the following wounds more especially.

Large wounds of the lungs.] All the blood of the body returned by the veins, is received by the right ventricle of the heart, which propels the same through the lungs into the left ventricle; so that when the lungs are injured with a large wound, the blood will be extravasated from thence by the force of the adjacent heart, whence it will not pass to the left ventricle but out of the wounded vessels, either into the cavity of the lungs destined for the reception of air, or else into the cavity of the thorax, so as to hinder the free expansion of the lungs; from whence it is very apparent, that such wounds must be attended with fatal consequences.

The fatal events of wounds in the lungs may also appear from practical observations. The thorax of a person was perforated with a paper bullet shot from a gun, which considerably lacerated the left lobe of the lungs and its vessels; the patient survived a day and a night with a considerable hæmorrhage, difficult respiration, &c. and then died (*h*). In the same place we are also furnished with two more instances to the same purpose. We have indeed some observations among authors, which teach, that wounds of the lungs have been cured; but then they were either slight, or such as the Surgeon could have access to, as we find in Hil-danus (*i*), that part of the lungs being protruded thro' a wound of the thorax, it was afterwards cut off with a hot instrument of steel, the patient being afterwards cured. The same author has another observation (*k*) not a little surprizing, in which a wound of the thorax was attended with a very difficult respiration, cough, and spitting of blood, &c. demonstrating that the lungs

(*h*) Bohnius de renunciatione vulnerum, pag. 233.

(*i*) Centur. 2. Observ. 32.

(*k*) Centur. 2. Observ. 46.

lungs were wounded, and yet notwithstanding the patient recovered, and three months after the wound was cured, coughed up a tent with a quantity of matter, which the Surgeons had imprudently left in the cavity of the thorax. If therefore a patient dies after a wound of the thorax, and upon opening the body the lungs appear injured, the Surgeon may then justly report to the judges, that the wound was the cause of the person's death; and this notwithstanding we have some few instances of wounds in the lungs being cured. Even in slight wounds of the lungs, there is great danger of their degenerating into an ulcer of that viscus, which will afterwards slowly destroy the patient by a tabes or consumption, of which we have an instance in Forrestus (l).

Of the liver.] For the blood of the abdominal viscera being collected by the vena portarum, is thereby carried to the liver; and the trunk itself of the vena cava ascendens also arises in part from the liver; and the whole substance of this viscus is soft, and in appearance full of blood. The hepatic arteries are indeed very small, in comparison of the bulk of the liver; but then the branches of the vena portarum, distributed like an artery through the same viscus, are very large and considerable; whence it is evident, that wounds of the liver are always very dangerous, if not constantly mortal; but when any of the large blood-vessels are divided, they will also bring on death very speedily, by the great quantity of blood extravasated into the cavity of the abdomen, or discharged by the wound externally, whence a speedy deliquium and death. *Faculo in jecur cominus percusso, statim cadaverosus color affusus est, oculi concavi, anxietas, corporis jactatio, mortuus est, prius quam concio dimitteretur, eodem quo percussus est die (m):* “ A dart being suddenly
 “ thrust into the liver, the patient immediately be-
 “ came all over of a cadaverous hue, his eyes hollow,

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“ his

(l) Observ. Chirurg. Lib. VI. Observ. 4.

(m) Hippoc. Epid. 7. Chart. Tom. IX. pag. 567.

“ his body restless and full of anguish, dying the same
 “ day that he received the wound.” But it is very
 apparent, that those wounds of the liver are the most
 dangerous, which are inflicted near the entrance of
 its blood vessels, and which are therefore reckoned in-
 curable by Celsus (o), who always thinks those wounds
 difficult to cure, which divide the thick substance of
 the liver, though they are not absolutely incurable.
 We have a remarkable instance of a cure of a wound
 in the liver, related by Hildanus (p), in an epistle to
 Sennertus, in which a large wound was inflicted in the
 right hypochondrium, with so profuse an hæmorrhage,
 as brought on a deliquium; and a piece of the liver
 was extracted with the forceps as it presented itself at
 the mouth of the wound; and though the superven-
 ing symptoms were extremely severe, yet the patient
 was perfectly cured; but he dying three years after-
 wards of a continual fever, upon opening his body,
 part of the lower lobe of the liver was found cut off,
 and the wound well cicatrized. But then it is evi-
 dent from this history, that the wound did not pe-
 netrate to any of the large hepatic vessels or their
 branches: and there are again many slight wounds of
 the liver, which though not presently mortal, have
 yet proved fatal in their events. *Lictor imperterritus,*
injecturus vincula audacissimo cuidam nebuloni, ictus fuit
bipenni, in infima jecinoris fibra. Cujus exstillans san-
guis, in pus conversus, conjecit ipsum in lentam febricu-
lam: utique tam vehementem universi corporis marcorem,
ut conficeretur ante diem quadragesimum (q). “ A bold
 “ officer being about to secure an impudent knave,
 “ was stabbed in the lower lobe of the liver; from
 “ whence blood was discharged at first, which after-
 “ wards turned to a matter, and threw him into a
 “ hectic or slow fever, with so great a consumption
 “ throughout the whole body, that he died within
 “ forty days.”

Of

o) Celsus, Lib. V. cap. 26. (p) Cent. 2. Observ. 54. p. 110.
 (q) Tulp. Observat. Medicar. Lib. II. cap. 26.

Of the spleen.] Notwithstanding Democritus (*r*) says, that the spleen is a dormant and useless, or even pernicious, part of the body, in opposition to the liver; and though it appears from experiments in live animals, that the spleen may be cut out, and they survive without any great injury to their health; and even though we read (*s*) of instances of this part being extirpated in men, yet it has such large blood-vessels, and is seated so near the heart, that there is great reason to fear a fatal hæmorrhage from wounds of the spleen. We have even a proof that wounds in this part have been mortal from practical observations: *Inter ludicra puerilia, ictus fuit scipione, in regione lienis, juvenis quatuordecim annorum, cum insigni dolore, & tam frequenti animi deliquio, ut postridie ejus diei vitam cum morte commutaverit* (*t*); “Among lads at play, one of fourteen years of age was wounded in the region of the liver with a stick, being followed with great pain, and such frequent fainting fits, that he died the next day.” The same author has another case like the former, and upon opening both bodies, the spleen was found wounded in its concave part, big enough to receive two fingers. We have also two instances of the spleen being wounded by a blow externally, which was followed with sudden death; and a large quantity of extravasated blood was found in the cavity of the abdomen, according to the observation of Bohnius (*u*).

But it is very probable, that slight wounds of the spleen are not absolutely mortal, any more than those of the liver, notwithstanding they are never without danger.

Of the kidneys.] Those are incurable, according to Celsus (*w*), who have their kidneys wounded. Whoever

(*r*) Epist. ad Hippoc. de natura humana, Charter. Tom. I. p. 29.

(*s*) Boyle de utilitate Philosoph. Experimentalis Exercit. I. pag. 109, 110. Miscell. curios. dec. 1. ann. 4 & 5. pag. 210. & dec. 2. ann. 3. pag. 378. & ann. 7. pag. 293. (*t*) Tulp. Observ. Medic. Lib. II. cap. 29.

(*u*) De renunciatione vulnerum, pag. 281.

(*w*) Lib. V. cap. 26.

ever considers the largeness of the emulgent arteries, will readily believe, that if any of their large branches be wounded, either at the entrance or within the substance of the kidney, it must be followed with a fatal hæmorrhage; and if the peritonæum be wounded at the same time, the blood will then escape into the cavity of the abdomen; but if the kidney be injured with a wound inflicted on the back part of the body, the peritonæum remaining entire, there will then follow a surprising extravasation of the blood into the cellular membrane, interposed betwixt the peritonæum and muscles, nor can the blood then flow so freely from the wounded kidney. This is true, notwithstanding that passage of Hippocrates, where he orders nephrotomy for a stone in the kidney, saying, *Quum dolor urget, multa calida lavato, & qua parte præcipue dolor est, fots tepentes admoveto; quum vero intemuerit, & extuberarit, sub hoc tempus juxta renem secato* (κατὰ τὸν νεφρον) *& extracto pure, arenam medicamentis urinam moventibus curato, &c.* (x) “ In the
 “ paroxysm, let the part be well fomented where the
 “ pain is severest; and when a tumour is formed
 “ make an incision near the kidney, and after ex-
 “ tracting the matter and gravel, compleat the cure
 “ with diuretics, &c.” It is very apparent, that he does not intend a division of the kidney itself, nor would he have the stone or gravel extracted by the wound: but we shall hereafter take notice of what one ought to think concerning this passage, when we come to treat of the stone.

But that all wounds of the kidneys are not mortal, may appear from the observation of Forestus (y), concerning a young man twenty years old, who was wounded in the loins with a knife, in the region of the right kidney, his urine was totally suppressed for six days by the blood which escaped from the wounded kidney into the bladder; and yet he happily recovered,

(x) De internis affectionibus, cap. 15. Chart. Tom. VII. p. 649.

(y) Lib. XXV. Observ. 20. pag. 194.

vered, as well from the wound, as the suppression of urine.

Of the pancreas.] For if the trunk or large branches of the blood vessels in this viscus be divided, the blood may from thence pass into the cavity of the abdomen, and by putrifying afterwards, death may follow as the consequence of the wound. But yet as the pancreas lies under the stomach, it cannot well be injured, without the wound passes through some of the other viscera at the same time.

Of the mesentery.] The large blood-vessels distributed through the mesentery, with the order of their course, are beautifully represented by Eustachius, Tab. xxvii. fig. 23; for besides the large branches of the vena portæ and vena cava, there are also very large arterial trunks distributed through the mesentery, *i. e.* the arteria mesenterica superior & inferior; and therefore those vessels being wounded, may produce a fatal hæmorrhage, so as to fill the cavity of the abdomen with extravasated blood. A case of this kind we meet with in Bohnius. (z), where the patient died the third day after a stab in the epigastric region; and upon opening the body, the wound was observed to penetrate through the omentum into the center of the mesentery, so as to divide not only the smaller vessels of the epiploon, but also a larger branch of the superior mesenteric artery; from whence the abdomen of the patient, which was very large and obese, was swelled with extravasated blood inclining to putrefaction. Death has been also the consequence from a rupture of the vessels of the omentum, the hæmorrhage proving so large as to fill the whole cavity of the abdomen (a).

But there is yet another dangerous consequence to be feared from a wound in the mesentery, for the knowledge of which we are chiefly indebted to the celebrated Ruysch; for that anatomist being employed for above fifty years together by publick authority,

to

(z) De renunciatione vulnerum, pag. 264. (a) Comment. Acad. Scient. Imperialis Petropolit. Tom. I. pag. 382, 383.

to examine the dead bodies which were either killed or murdered in the very populous city of Amsterdam to make a report concerning the state of their wounds to the judges, has frequently had opportunity to observe, that wounds of the mesentery have proved mortal within two or three days; the patient being first afflicted with continual and excruciating pains of the abdomen, and yet upon the strictest examination no other part of consequence besides the mesentery appeared injured: add to this, that the poulterers when they castrate cocks, always kill the animal immediately, if they perceive the mesentery the least injured in the operation; being taught by experience, that it will otherwise die in a short time from the wound (b.) But the mortality of such a wound seems to arise from the injury of the mesenteric nerves; and the great influence which the nerves of the abdominal viscera have upon the vital functions, is apparent from daily observation, in the several species of incarcerated ruptures and inversions of the intestines.

And perhaps something of the like nature may be intended in the Prognostics of Hippocrates (c), where it is said, *Pereunt & quibus nervi interiores, sive tenuis aliquis, sive crassus vulneratus fuerit, si plaga transversa fuerit & magna; quod si parva & recta, nonnulli evadunt*: “ Those perish who have any of the small or
 “ large nerves of the intestines wounded, if the wound
 “ be transverse and large; but if it be narrow and
 “ small, they sometimes escape.” Cornarius reads, *επτετα* for *επτε*, which reading brings the sense of that passage nearer to this opinion (d).

The stomach and intestines.] In this number we are to consider the wounds of these parts so far as they may prove mortal, by an extravasation of their blood; since we shall hereafter, in the fifth number of this section, consider the disorders which follow a discharge of the contents of the stomach and intestines through a wound.

(b) Ruysch adversar. Anatom. decad. 2. No. IV. pag. 8, 9.

(c) No. 509.

(d) Foësius, Tom. I. pag. 200.

wound. The stomach is encompassed with large blood-vessels, which invest both its orifices, and descend from thence towards its fundus, where they inosculate frequently with their own kind of vessels ascending from the bottom of the stomach; whence it happens, that one branch being divided, the blood of all the other branches easily escapes from that wounded. Many instances of people dying after wounds in the stomach, are recorded by writers of observations; but may be sufficient for our purpose, to remark only one, which shows how profuse an hæmorrhage may hence arise. A country gentleman was wounded with a very broad sword in the right hypochondrium, under the false ribs; he discharged much blood by vomiting and by stool, after which followed sweats, swooning, coldness of the extremities, convulsions, and death on the third day. After opening the abdomen, a large wound appeared in the bottom of the stomach, which divided the arteries and veins, which are there plentifully distributed; and a large quantity of blood was found extravasated in the cavity of the abdomen.

But the intestines are supplied with their blood-vessels from those of the mesentery, to which they are connected; the branches of the mesenteric vessels communicating afterwards by frequent anastomoses in that part of the intestines opposite to the mesentery; and therefore wounds of the intestines, especially those inflicted near the mesentery, will divide many large vessels, from whence will follow a profuse hæmorrhage in the cavity of the abdomen, and death itself. A man was wounded with a sword in the right hypochondrium, a little above the umbilical region, he afterwards complained of a violent pain in the abdomen, discharged much blood by stool, and had convulsive motions in his stomach: hiccups (*f*), frequent faintings, and in four hours time he expired.

Upon

(*e*) Boneti Sepulchretum, Tom. III. pag. 362.

(*f*) Bonet. *ibid*.

Upon opening the abdomen, and removing the blood and fæces with which its cavity was filled, the intestine colon appeared totally divided transversely, and was become sphacelated.

But the danger seems to be much greater, when the large blood-vessels of the stomach and intestines are wounded, on the account of their continual peristaltic motion, which constantly agitates and separates the wounded parts. And possibly the same symptoms may arise from an injury of the nerves, sent to the stomach and intestines, as were just now observed to follow wounds of the mesentery.

But notwithstanding this, we meet with frequent examples of wounds in these parts being cured; whence we may conclude, that all wounds of the stomach and intestines are not mortal.

[Of the uterus in pregnant women.] After a woman has conceived, the uterus begins to dilate or enlarge itself every way, and all its vessels are proportionably more distended, with a larger quantity of juices to supply the impregnated ovum; hence the uterus of a pregnant woman has almost the same thickness which it had in the contracted state of non-gravitation, and yet does it so enlarge or distend its bulk, barely by a gradual dilatation, and a greater repletion of its vessels. Whence Hippocrates says, (g) *Ubi in utero mulier gerit, paulatim a toto corpore sanguis in uterum deferitur, & in orbem id, quod in utero est circumstans, ipsum auget*: “When a woman is
“pregnant, the blood is gradually drained from the
“whole body to her uterus, which it dilates by stay-
“ing or residing in the conception, &c.” And from thence he deduces a reason why pregnant women have a depraved colour, namely, because the pure blood is daily drained from the body, and carried to the fœtus, &c. as we read in the same book de Morbis Mulierum (h), which passage I before quoted in §. 69. numb.

(g) De mulier. morbis, Lib. I. cap. 23. Charter. Tom. VII. pag. 744.

(h) Charter, Tom. VII. pag. 748.

umb. 2. Hence then it is apparent, how dangerous the wounds of the uterus, when it is impregnated, since the vessels are then distended with so large a quantity of blood. The danger of wounds in this part is still further increased, because the foetus distending the wounded uterus, prevents it from contracting and closing its vessels; but if the foetus is excluded soon after the wound inflicted, there is then some hopes that the uterus contracting will stop the hæmorrhage, and dispose the wound to be afterwards healed. We have, indeed, some surprizing instances of this nature, where the mother has survived after the uterus has been cut open, and the foetus extracted by a large wound. A woman having the vagina injured in her first delivery, the sides thereof were grown together so, as afterwards to be scarce capable of admitting a pea; and upon a second impregnation, when the birth approached, and there was no hopes of procuring a passage to the head foetus, the abdomen has in that case been opened by incision, together with the uterus, and the foetus extracted without any fainting fits, or other bad accident happening to the mother, who survived the operation. (i) Another instance of the Cæsarean section, as it is called, we have confirmed by publick testimony in the Memoirs of the Royal Academy. A woman of forty years of age, in her first lying-in, could not be delivered from a stricture in the passage, notwithstanding all means were tried to no purpose; but on the fourth day, a very skilful and intrepid midwife performed the Cæsarean section, and extracted the foetus from the womb, without inducing any bad consequences, the mother afterwards recovering, and enjoying her health (k).

Of the bladder near its larger arteries] Notwithstanding Hippocrates (l) has pronounced wounds of the bladder

(i) Aët. Lipsiens. an. 1693. pag. 230.

(k) Academ. des Sciences, l'an. 1731. Hist. pag. 51.

(l) De morbis, Lib. I. cap. 2, Charter. Tom. VII. pag. 432. & ibid. cap. 4. pag. 536. uti & in Coacis Prænotionibus, No. 503, 504, 509.

bladder to be mortal, and incapable of healing, it is yet evident from daily and frequent observation, that the bladder being wounded in cutting for the stone, does afterwards heal, but yet there is danger of a profuse or fatal hæmorrhage, from the division of the considerable blood-vessels which the bladder receives from the adjacent trunks of the Iliac arteries, which bleed very impetuously. The origin and course of these vessels are given us by Eustachius in Tab. XII. fig. 1. But the hæmorrhage is more dangerous in lithotomy, because the bladder grows thicker from a stone, and thence its blood-vessels are proportionably larger: if now these vessels are wounded while the stone resides in the bladder, that receptacle cannot totally contract itself; but the vessels continue bleeding with open mouths. But when the stone is extracted, and the bladder collapsed, the urine then flows through the wound, and the divided vessels close.

The aorta.] The blood returning from the lungs into the left auricle and ventricle of the heart, is all driven afterwards into one large artery, termed the aorta, which is distributed throughout the whole body, forming first an arch or curvature before it descends upon the vertebræ of the spine, a little inclining to the left side, down to the os sacrum, where it divides into two equal branches, termed, the Iliac arteries, but retaining the name of aorta all the way from the heart, to this bifurcation or division. Hence it is very evident, that if the aorta itself be wounded; there can be no relief, since it is not accessible to the Surgeon, but soon proves mortal, by deriving and extravasating the blood impetuously from the heart. For a wound in this artery is inaccessible, and proves the sooner mortal, as the wound is inflicted nearer the heart.

Of the carotid.] The carotid arteries arise from the curvature of the aorta, after its egress from the left ventricle of the heart, (at least the left carotid arises thence, though the right generally springs from the

subclavian artery of the same side) and both of them ascending on each side the trachea up to the larynx, they there divide each into two considerable branches, one of which being spent in the parts without the cranium, is termed the external carotid, while the other entering through the cranium, and being spent in the encephalon, is called the internal carotid. But all the way from where they arise at the aorta and subclavian, to where they divide each into two branches, they are only termed simply carotids. These arteries are in a man almost as large as the little finger, whence one may easily conceive how great an hæmorrhage must follow from a division of them, especially considering the vicinity of the heart forcibly propelling the blood into them. But it is also remarkable, that these arteries are seated so shallow, or near the integuments, almost all the way of their course, that one may very easily perceive their pulsation in the neck with one's finger. There is indeed some reason to think, that one of the carotid arteries might safely be secured by ligature, without bad consequences, since the other carotid and vertebral arteries may supply a sufficient quantity of blood to the brain and cerebellum. I have indeed myself observed in a dog, whose two carotid arteries I tied eight days after I had cut the recurrent nerves, that he suffered no apparent disorder from thence; for he appeared brisk and strong eight days afterwards, at which time I also tied the jugular veins without any remarkable effect, finding him well four days after. Upon examining the ligatures they all appeared firm, and there was a large and compact thrombus, or concretion of the blood, betwixt the ligatures and the heart. Upon opening the cranium no disturbance appeared in the brain, but its bulk seemed rather increased than diminished.

But if we consider the difficulties that will attend this operation, when a carotid artery is wounded in the human body, it will appear very evident, that such a wound ought to be deemed mortal; for the

hæmorrhage is so profuse, that the patient may expire in a few minutes time. In order therefore to preserve a patient thus wounded, it is absolutely necessary for an expert Surgeon to be ready at hand the very moment it is inflicted, that he may compress the two ends of the wounded artery with his fingers against the resisting trachea; while ligatures are at the same time made about the limbs, to prevent the blood from returning too plentifully to the heart by the veins, which being compressed, will diminish the impetus or velocity of the effluent blood. After this has been done, both ends of the divided artery ought to be found and then tied; for it is not sufficient to tie the end of the artery next the heart only, because the carotids, communicating openly with each other, and with the vertebral arteries at the basis of the brain, the blood would continue to run from the upper orifice. From all this it is evident, that one Surgeon, though expert, will not be sufficient, but that two such are required. Add to this, that it seems scarce possible to discover the ends of the divided artery, without opening the integuments, or enlarging the wound; whence the patient's death might be imputed to the wounds made by the Surgeons, even though they used their best endeavours, and rather deserved much applause. But notwithstanding this, if the patient should fall into a deliquium from the loss of blood, so as almost to restrain the hæmorrhage, it may then perhaps be proper to try the operation.

[Vertebral arteries.] The vertebral arteries arising from the subclavians on each side, ascend towards the cranium through the foramina of the transverse processes of the vertebræ of the neck; and in their progress they send off small arterial branches through the commissures of the vertebræ, to the spinal medulla and its integuments. Hence it follows, that these arteries being divided, cannot easily fly back to be compressed so as to close their orifices; and since they again communicate at the basis of the brain, with the inter-

al carotid arteries, hence the blood sent up by the carotids will return through the wounded vertebrals, whence the danger of a wound in these latter is sufficiently apparent. Besides this, there is no opportunity of applying a ligature to the divided extremities, which lie concealed within the bony foramina; to that there only remains some small hope, that if the patient be much weakened with the hæmorrhage, and supported in that low state by a nourishing and soft or mild diet, without any cordials or incentives to the blood's motion, that then the extremities of the divided arteries may collapse and close. And that this is not altogether impossible, may appear from those wounds in the heart which have been cured, and particularly from that instance which we mentioned (§ 161.) where the axillary artery being divided, the patient notwithstanding recovered.

From what has been said it is sufficiently apparent, how dangerous are wounds of the other large arteries, such as the emulgent, iliacs, &c.

But that wounds of the larger veins are also equally mortal for the same reasons, is likewise sufficiently evident; only as most of the veins are situated more superficially in the body, they may be therefore more easily compressed; nor is the velocity of the blood so great in the veins as in the arteries; and therefore wounds of the former are, *cæteris paribus*, less dangerous than the latter.

4. Those wounds which entirely destroy respiration, such as a division of the larynx, with a retraction of the divided trachea, large wounds of the bronchia, broad wounds penetrating into both cavities of the thorax, admitting the external air, wounds of the diaphragm penetrating it on each side of the mediastinum, or a division of its nerves.

In every animal; except while in the womb, it is necessary for the blood to pass from the right to the left ventricle of the heart, by a dilatation of the lungs with air, that so the blood may have a free passage through the pulmonary artery of the right ventricle, into the pulmonary vein of the left ventricle; *i. e.* respiration is absolutely necessary to the continuance of life; which soon perishes, if that action be suspended but for a few moments: but in order to respiration, it is required for the air to have a free passage into the lungs to expand them. All wounds therefore which destroy the ingress of the air into the lungs, and thereby prevent their dilatation, are mortal; and such are the following.

A division of the larynx, with a retraction of the divided trachea.] The windpipe consisting of cartilaginous segments, never collapses, nor is easily compressed, but always remains open, and gives a free passage to the air into the lungs; but when this tube is divided so, that the lower extremity thereof is retracted; and concealed within the adjacent parts, the air is denied admittance, and death follows. But if the windpipe be injured even with a large wound, and the air notwithstanding has a free passage into the lungs, that wound will not in the least prove mortal, as we are assured from incontestable observations. Physicians and Surgeons have frequently met with cases, in which people being weary of their lives, have laid violent hands on themselves; or in which the throat has been cut by robbers, and yet they have been cured notwithstanding. We shall only relate a few instances to prove this assertion. A young man being melancholy at the disappointment of his nuptials, which he expected, cut his throat, or rather divided the cartilages of the windpipe, without injuring the carotid arteries and jugular veins on each side of it, after which he fell down speechless. A Surgeon having brought the lips of the wound together, conjoined them by suture, but the miserable patient, undesirous of life, tore

tore open the future; the lips of the wound were therefore conjoined again by future, and with a plaster, spread with carpenters glue, so that they united, and the wound was healed in the space of a month. No other defect remained after the cure, than that the patient was obliged to sing in consort with a note much lower than before the wound was inflicted (*m*). A like case may be also found in Bartholin (*n*) of a girl who cut her own throat, and who also tore open the future of the wound, that was afterwards cured.

Three instances of this nature are found in Parey's Surgery (*o*), where a man cut his windpipe, together with one of the jugular veins, and immediately lost his voice after the wound was inflicted; but when the wound was conjoined by future, he could then speak, and afterwards did well beyond expectation; for Parey imagined that he would soon expire. In the two other cases, the œsophagus was also divided with the windpipe, whence they both expired four days after the wound was sewed up; so that one discovered the murderer, and the other confessed himself the transgressor, and thereby cleared the family from all suspicion of the crime.

I remember a soldier, a few years ago, that begged his way, who made a show of a large wound, or aperture, in his windpipe, which he used to stop with a sponge, and then he could speak very well, but upon opening the hole he lost his voice. This accident arose from part of the windpipe being tore off by a bullet in battle; so that the lips of the wound could not be afterwards brought together, without leaving a considerable aperture, though he survived the accident for many years.

Large wounds of the bronchia.] The windpipe having descended along the forepart of the neck into the thorax, divides itself into two branches at the curvature of the aorta, forming the two lobes of the
H 3 lungs;

(*m*) Tulp. Observat. Medic. Lib. I. cap. 50. (*n*) Thom. Barthol. Hist. Med. Cent. V. Hist. 89. (*o*) Lib. X. cap. 31.

lungs; these branches lose the name of trachea or windpipe, and are called bronchia; as likewise are denominated their several branches into which they subdivide within the lungs: since therefore the office of the trachea and bronchia is to convey the inspired air into the lungs and their vesicles, if they are wounded considerably the air will escape, and be collected within the cavity of the thorax, where being expanded by the warmth of the parts, it will compress the lungs, and destroy their action: whence suffocation and death; especially if the bronchia of both lobes of the lungs are injured at the same time, for then respiration is totally destroyed. Hence Hippocrates says (p), *Moritur, si in arteriam (asperam hoc nomine semper intelligens) & pulmonem magnæ admodum plagæ inflictæ sunt, sic ut percusso pulmone minor sit, qui per os prodit, spiritus, quam qui per vulnus excidit,* “ The patient dies when a very large wound is inflicted either in the lungs or the artery (meaning the windpipe or aspera arteria) so that the lungs being wounded, more air passes through the wound than by the mouth.” But the danger of these wounds is still increased, from the vicinity of the pulmonary blood-vessels, which are distributed together with the bronchia, and ramified with each other in the lungs, so that one cannot be considerably wounded without the other.

Broad wounds penetrating and admitting the air into both cavities of the thorax.] While the thorax is exactly closed on all sides, the lungs contained in its cavity are always more distended, than if they were exposed on all sides, to the open air, in which they collapse or shrink up into a smaller compass, in a great measure from a contraction of the muscular fibres, which connect the cartilaginous rings of the bronchia to each other. For naturally there is no air in the thorax betwixt the lungs and the pleura, but the air has a free passage always into the lungs through the

the glottis, so that the lungs being more pressed or
 distended by the air, admitted through the glottis,
 than by the external air pressing upon the ribs and dia-
 phragm, they must necessarily dilate, because the
 arched figure of the ribs and diaphragm, connected to
 them and the vertebræ, hinders the external air from
 pressing the diaphragm so far into the thorax, as to
 make an equilibrium betwixt the external air and that
 contained in the lungs. This is the reason why the
 lungs always remain contiguous to the pleura, not only
 in the living animal, but even after death, so long as
 the cavity of the thorax is entire; which evidently
 appears, if the intercostal muscles be carefully removed,
 without injuring the pleura; for then the lungs ap-
 pear visibly contiguous to the pleura, which is thin
 and almost pellucid. But when the pleura is perfo-
 rated, the air rushes into the cavity of the thorax, and
 the collapsed lungs immediately contract into a smaller
 compass, so as to recede from their contact with the
 pleura, while the diaphragm at the same time grows
 flaccid, and descends into the abdomen, though it
 was before tense, and thrust up into the thorax with
 its concavity towards the abdomen. From all this it
 is evident, that the lungs are naturally in contact on
 all sides with the pleura, and that there is no air re-
 sides betwixt the concave surface of the lungs, and the
 concave superficies of the pleura, which are adapted
 to each other. When the ribs therefore are elevated
 and drawn from each other by the muscles of respira-
 tion, the diaphragm being at the same time contracted
 and flattened, the cavity of the thorax is thereby
 enlarged, so as to form an empty space void of air
 betwixt the lungs and the pleura; and thus respiration
 is performed. But when the cavity of the thorax is
 perforated, and the air freely admitted, its pressure then
 equals that of the air admitted through the glottis,
 whence the lungs will not be dilated from the equi-
 librium, but will shrink up into a less space from their
 natural propensity to contraction. If now this ad-

mission of the air be made in both sides of the thorax, then both the lobes of the lungs will collapse, and not be dilated by the inspired air; hence the right ventricle of the heart will not be able to propel its blood through the arteries of the collapsed lungs, and therefore the motion of the heart, with the several actions of life thence resulting, will cease in a short time.

These experiments have been long ago tried even by Galen (*q*) upon living animals, who from thence concludes, *quod ideo semivocale & semirespirans ilico fiat animal à magnis vulneribus alterutram thoracis partem penetrantibus; voce autem & respiratione penitus destitui, si ambæ cavitates perfossæ fuerint*; “ that animals lose
 “ half their voice and respiration from a large wound
 “ penetrating the cavity of the thorax on either side;
 “ but that the voice and respiration is totally destroyed, when wounds perforate both cavities of
 “ the thorax.” And from hence he deduces the use of the mediastinum, separating the thorax into two cavities, to be designed for preserving respiration entire in one half of the lungs, when it is destroyed in the other half by a wound perforating either side of the thorax. Vesalius (*r*) has also demonstrated by the dissection of living animals, that after denudating the pleura, the lungs always appear and continue contiguous thereto; but that after perforating the pleura, the lungs in that side of the thorax collapse, notwithstanding the ribs and muscles are moved as at first; afterwards opening very largely the same side of the thorax, by cutting away several of the ribs, he could see, through the membranes of the mediastinum, the manner in which the other half of the lungs performed their action, as they follow the motion of the entire side of the thorax, whose membranes being also perforated, that half of the lungs immediately collapses like the first.

These

(*q*) De usu partium, Lib. IV. cap. 3. Charter. Tom. IV. pag. 419.

(*r*) Vesal. de corporis humani fabrica, Lib. VII. cap. ult. pag. 571.

These experiments seem to infer, that wounds, penetrating the cavity of the thorax on each side so as to admit the air, must be certainly and speedily mortal: but how far this is true will appear from the following experiments.

About twelve years ago, if I rightly remember, I dwelt in this university Dr. WILLIAM HOUSTON, a man of singular learning, especially in anatomy and botany, in behalf of which latter he underwent long journeys, shipwrecks, and imprisonments with many other disasters; after which, returning into his own country, he there perished in the flower of his age by a lingering disorder, to the great damage of the sciences, being worthy of a life much longer. I enjoyed the conversation of this gentleman to my great advantage, and must greatly acknowledge, that I learnt many things of him. He one day asked me, whether wounds, penetrating both cavities of the thorax, were mortal? I answered in the affirmative, and endeavoured to prove the truth of the assertion by the arguments before alledged: he courteously heard the reasons, and then laughing took a little dog from his bosom, which he had perforated in both sides of the thorax about three days before, and the animal ran about as briskly as if nothing ailed it. Upon examining the wounds as carefully as possible, I saw that they penetrated into the cavity of the thorax, and that the lungs did not adhere to them, as I at first suspected. Upon placing a small wax candle near each of the wounds, it was blown out by the air drawn in, and driven from the wounds. I stood amazed at the uncommon spectacle, and afterwards repeated the same experiment upon several other dogs; the success of which was as follows:

I perforated the anterior part of the thorax in a dog on the left side, and the air instantly rushed in with a noise, and by introducing a tube I removed the lungs on all sides from the pleura. I afterwards inflicted a wound also on the right side of the thorax.

and by introducing my finger freed the lungs every way from the pleura, and upon taking out my finger again, a great part of the lungs were forced out thro' the wound; but the dog notwithstanding continued to breathe and cry out; and though I thrust the lungs again into the thorax with my finger, they came out again afterwards. The hæmorrhage was pretty considerable, and the animal expired in a quarter of an hour.

Repeating the same experiment upon another dog, I blowed air strongly through a pipe by the wounds; the animal lived longer in this case, but then the hæmorrhage was not so profuse. When the animal was still, the lungs continued within the cavity of the thorax; but when it struggled, by reason of the great pains, part of the lungs were then thrust out through the wound.

In another dog, whose thorax I perforated on both sides as before, after inflating the cavity of the thorax by a tube, I then divided the windpipe, and opened the whole abdomen by a crucial incision; then perforated the diaphragm on the left side, the wound penetrating into the same cavity of the thorax: after untying the animal he lived about three hours, running up and down the chamber with his intestines hanging out of the abdomen.

But I was still more surprized in another dog, who lived five hours after the thorax was perforated on each side, the abdomen opened, and the diaphragm also perforated on both sides.

I several times repeated these experiments, and almost always with the same success: but when I perforated the thorax with very large wounds, running parallel betwixt the ribs half the length of one's finger, and sometimes as long again or longer; in that case I found the animal quickly expire: but then the hæmorrhage was always very profuse.

Upon making an enquiry, in company with my other friends, who helped to make the experiments,

after

after the reason why the animal continued to live and breathe after both sides of the thorax were perforated, we came into the following opinion: that if the wounds inflicted had a less aperture than the rima of the glottis, then the air meeting with an easier passage through the aperture of the glottis than through the wounds, would then distend the lungs, and the reverse. This was countenanced from the animal's so very strongly endeavouring to expand the lungs, that they frequently protruded through the wound, and by that means prevented the free ingress of the air into the cavity of the thorax: and then we could also evidently perceive, that the animal very much diminished the aperture of the wound by drawing the ribs together. But that we might be sure of the truth of this opinion, we made the following experiments.

We made a pretty large wound on each side of the thorax in a dog, at about the middle of the space betwixt two of the ribs; and then we inserted tubes of tin, whose apertures were much larger than that of the glottis in this animal: by this means the wounds were kept open, and respiration instantly ceased, the voice was lost, and the animal seemed as dead; but upon stopping the orifices of the tubes with our fingers, or strongly pressing or rubbing the abdomen, the animal quickly began to breathe again, and by lifting up the fingers and closing them again to let out part of the air included in the thorax, the respiration still grew stronger, and the animal recovered his voice; but upon leaving the tubes open again as before, the respiration ceased, the voice was lost, and the animal expired. This experiment we several times repeated, and always with the same success. We also observed, that unless the tubes were held fast in the wounds, the animal would struggle with all his might to agitate the thorax and shake them out of the wounds, that by the closer approximation of the ribs he might continue to breathe.

From hence we may reasonably conclude, that wounds, penetrating both sides of the thorax, and admitting the air, are not speedily and certainly mortal, but when their opening exceeds that of the glottis.

But we may perhaps trace the foot-steps of this phænomenon in the passage before quoted from the prognostics of Hippocrates; who says, that a man dies, (*si percusso pulmone minor sit, qui per os prodit spiritus, quam qui per vulnus excidit;*) “ if the lungs being “ wounded, more air be drawn in and out by the “ wound than by the mouth.”

I do not remember to have read one instance among the writers of observations of a man's being wounded, so that his death could be ascribed only to the ingress of the air into both cavities of the thorax; for the viscera of the thorax are almost constantly injured at the same time. There is indeed one account in Schenckius (s) of a man, who falling off from a tree upon a sharp stick, it perforated through the muscles of his loins up into the cavity of his thorax: and after the wound was cured, a fistulous aperture remained in his back, which opened into the cavity of the thorax, and by which the flame of a candle held near would be agitated and sometimes extinguished; tho' he survived in that manner without any apparent disorder for many years.

Wounds penetrating the diaphragm into the cavity of the thorax on each side the mediastinum.] The cavity of the thorax is on all sides invested with a membrane called the pleura, but so that the pleura of each cavity is distant from the other. The two pleuræ may be therefore conceived as two hollow bladders lying close by the side of each other, and growing together where they touch. The duplicature or contacts of these membranes are called the mediastinum, which divides the whole thorax into two cavities, though unequal, because of the inclination of the anterior part of the mediastinum towards the

(s) Lib. II. de vulner, thoracis, Observat, 3. pag. 297.

the left side, whereby the right cavity of the thorax is rendered larger than the left (*t*): But as the mediastinum is not a simple membrane, being formed by a conjunction of the two sacculi of the pleura, therefore Galen (*u*) speaks very justly, when he says in describing the membrane that lines the thorax, (*ὁ μὲν διαφραγματος τὸν θώρακα*) “that from thence arises the membranes which divide the thorax.” If therefore a wound perforates the diaphragm on each side the mediastinum, the air may enter thereby into the whole cavity of the thorax, and prevent the expansion of the lungs, in the same manner as we lately mentioned in wounds penetrating each cavity of the thorax.

But if we consider that the large liver, spleen, &c. are attached to the diaphragm, it will readily appear, that the diaphragm cannot well be injured or perforated on both sides of the mediastinum, without wounding some of the viscera at the same time; whence the mortality of such a wound cannot well be ascribed to the admission of air only into the cavity of the thorax. Even the action of the diaphragm and abdominal muscles pressing on the viscera would prevent the air from having a free passage through the wound into the thorax, which if granted, it follows from what we before advanced, that the aperture of the wounds must be considerably larger than the glottis; and therefore wounds thus stated can very seldom or never happen.

A division of its nerves.] The middle part of the diaphragm is termed its tendinous center, being a broad tendon or aponeurosis, into which all the fleshy fibres of that muscle terminate; it is also called the nervous part of the diaphragm, because the Antients gave the name of nerves also to the tendons. It has been thought, that the action of the fleshy fibres of the diaphragm was to draw the tendinous center of it down-

(*t*) Acad. des Sciences l'an. 1715. Mémoires, pag. 311, &c.

(*u*) De Anatom. admin. Lib. VII. cap. 2; Charter. Tom. IV, pag. 148.

downward on every side, so that if a wound be inflicted in the tendinous part, the half-divided fibres would be drawn asunder, and lacerated so as to increase the wound with intolerable pain, which would be followed with convulsions and death. But Mr. SENAC (*w*) has demonstrated, that the center or tendinous part of the diaphragm does not descend in inspiration, the pericardium including the heart being attached thereto; for the position and motion of the heart would be disturbed, since the pericardium adheres with its broadest side to this tendinous part of the diaphragm. And that this part of the diaphragm does not descend, he also proves from its structure and connection.

But there is notwithstanding another bad event no less fatal, which follows from a wound in the diaphragm; and though it does not destroy so suddenly, yet death certainly follows after the most direful calamities. For while the contents of the abdomen are pressed by its muscles and the diaphragm, they are forced through the wound in the latter, which they dilate, so as to pass into the cavity of the thorax, and then, by compressing the lungs and disturbing the action of the heart itself, death is brought on sooner or later, with the severest anguish. Thus Parey (*x*) affirms, that he saw a man who was wounded in the middle of the tendinous part of the diaphragm, which, though no larger than the breadth of one's thumb, the stomach was notwithstanding forced thro' the wound into the cavity of the thorax. In another person, who had been wounded above eight months, and who died after the severest cholicky pains, the intestinum colon was found the greatest part of it within the cavity of the thorax, though the wound in the diaphragm was no larger than to be capable of receiving the end of one's little finger. A like example is also to be met with in Sennertus (*y*), of a student

(*w*) Acad. des Sciences, l'an 1724. Memoir. pag. 251, &c.

(*x*) Liv. X. cap. 32. (*y*) Lib. II. part. 2. cap. 13. pag. 372.

udent who stabbed himself with his own sword, but was cured of the wound within two months after, and yet notwithstanding he expired, after frequent vomitings, seven months after the cure of the wound. Upon opening the body, the wound appeared to have penetrated through the diaphragm and lungs, but the whole stomach was forced up into the left cavity of the thorax, and the heart, with the pericardium, was thereby pressed into the right side; when the patient was alive and cured of his wound, he would often direct one to feel the palpitation of his heart, by applying the hand.

It is hence apparent, how dangerous are wounds of the diaphragm. But Hollerius, notwithstanding, testifies, that he observed the cicatrix of a wound which had been healed in the fleshy part of the diaphragm, in an executed body, which he saw dissected in the physic schools at Paris (z).

5. Those wounds which destroy the course of the chyle to the heart, such as a total division of the œsophagus, large wounds of the stomach, or an entire division of the small intestines in their upper part, and wounds of the thoracic duct, or receptacle of the chyle.

In this number are contained the wounds of those parts which are required to be sound or entire, in order to receive and digest the aliments, and convey the chyle thence prepared into the blood, to repair the several losses occasioned by the daily actions of life and health.

A total division of the œsophagus.] For an entire division of this part destroys all passage of the food to the stomach. But wounds of the œsophagus, which do not totally divide it, have frequently been cured.

Thus we read in Schenckius (a), *Quod homo quidem carceribus*

(z) Holler. Comment. in Aphor. sect. 6. pag. 344.

(a) Observ. Medic. Lib. III, Observ. 6. pag. 316.

ceribus detentus sibi ipsi guttur, qua parte tracheam arteriam spectat, ferro vulneravit, & digito vulnus tantopore ampliavit, ut per ipsum alimenta & medicamenta ad os usque transmitterentur. Sanatus tamen fuit paucis diebus: “ A man in prison, who cut his own throat, “ and so enlarged the wound with his finger, that his “ aliments and medicines had a free passage from his “ mouth through the wound, yet he was cured in a “ few days.” Another instance we have in Bohnius (b), of a young man whose throat was cut by robbers, and when he drank milk erect it ran out through the wound, but when he drank it lying on his back, it passed into his stomach, whence it was evident that the œsophagus was not totally divided, he being afterwards cured of the wound. But in a case where the œsophagus was totally divided, together with the trachea, it was so far retracted towards the stomach, that Parey, with all his skill, could not bring the two extremities to meet; he indeed united the divided wind-pipe by future, so that the patient recovered his speech sufficient to discover the author, but he expired the fourth day after the wound was inflicted. Another instance of the like kind is also given us by the same author (c). But as the œsophagus is covered with the trachea before, and lies incumbent on the bodies of the vertebræ which defend it behind, while on each side of it are placed the large blood-vessels, it therefore very seldom happens to be wounded alone, whence one might imagine the patient’s death to proceed partly also from the other adjacent parts wounded. We have a surprizing observation given us by the celebrated Boërhaave, which is, perhaps, the only one published, namely, the illustrious Baron Wassenauer, Lord High-Admiral to the Republick, after intense straining in vomiting, broke asunder the tube of the œsophagus, near the diaphragm, so that after the most excruciating pains, the aliments which he swallowed

(b) De renunciatione vulnerum, pag. 208.

(c) Les œuvres d’Ambrosie Paré Livre X. cap. 31. pag. 249.

owed passed together with the air into the cavity of the thorax, and he expired in twenty-four hours. But our celebrated professor (*d*) justly concludes, that if the same case should occur again, it might indeed be discovered by the history which he has given us, but yet it would be incurable by all means whatever.

Large wounds of the stomach.] All the solid and fluid aliment is, after swallowing, received into the cavity of the stomach, by whose structure, together with the juices poured into it, the aliment is so changed, as afterwards to afford a juice to be absorbed from the cavity of the intestines, by minute lacteal veins, from whence it is conveyed to the blood, to repair the several losses of the solid and fluid parts of the body, occasioned by the constant actions of life. If therefore a large wound is inflicted in the stomach, the contents thereof will escape either out of the body, or into the cavity of the abdomen, so that the act of nutrition will consequently be destroyed; to which add the great danger that naturally attends wounds of the stomach from its own structure, as consisting of so many arteries, veins, nerves, &c. with which its whole substance is replete. But when the patient expires by a wound of the stomach, soon after its infliction, his death then cannot well be said to be the consequence of the act of nutrition being destroyed, but death rather follows from the injury offered to the substance of the stomach itself, which is sufficiently evident. We have two instances of people wounded in the stomach, given us by Bohnius (*e*), in which death followed within two days time. But when wounds of the stomach prove mortal, from their rendering it incapable of containing the aliments, in that case death creeps on but slowly, and the body is gradually wasted. We are even furnished with some observations of such wounds, which have degenerated into fistulous ulcers, which have continued open, and

(*a*) *Atrocis nec descripti prius morbi Historia, &c. scripta ab Her-
manno Boërhaave.*

(*c*) *De renunciatione vulnerum, pag. 252.*

the patient surviving for many years; so that they could let out the aliment by the ulcer when they pleased, or else restrain it by closing the orifice of the wound with a proper apparatus. Of this we have two instances in Schenckius (*f*). But we are still furnished with instances of many wounds in the stomach which have been perfectly healed. A young Moor stealing some ripe Indian figs of the tree called *Musa*, after eating them greedily, his angry father-in-law, to revenge himself, made a wound so large in the stomach and abdomen of the lad with a knife, that the fruit which he had eat ran forcibly through the wound; but the friends of the wounded pursuing the old man, he then inflicted a wound of the same kind in his own stomach. The Surgeon coming four hours afterwards to both the wounded, conjoined the stomach and integuments of the abdomen by suture, leaving a small aperture for the matter to discharge itself. Both patients were seized with a fever, which lasted fourteen days; and the youngest was cured in about a month, but the old man, being in the sixtieth year of his age, was in more danger, and was much longer before he was cured, yet both of them were alive and well fifteen years after the wounds were cured (*g*).

These observations seem to teach, that all wounds of the stomach, even large ones, are not always absolutely mortal, provided the Surgeon's hand can have access to unite the wounded parts by suture. But there is still much greater hopes of a cure in small wounds of the stomach, provided it be not distended with solid or fluid aliment; for then the stomach remaining contracted, the wounded parts may unite.

An entire division of the small intestines in their upper part.] Such wounds seem to be absolutely mortal, because the ends of the divided intestine discharge the chyle into the cavity of the abdomen, where putrifying, it will destroy the several viscera contained

(*f*) *Observat. Medic. rarior.* pag. 348. *Phil. Transf.*

(*g*) *No. 420.* pag. 184. & *Abridg. Tom. VII.* pag. 506.

in that cavity, whence certain death. But if either by accident or art the end of the divided intestine grows to the external margin of the wounded integuments, there will then be a free passage for the contents of the intestines to pass out of the body, being forwarded by the peristaltic motion. The chyle, after passing out of the stomach into the intestines, is retarded by the great length and numerous convolutions of the latter, that it might not pass out of the body too soon before its nutritious juices are absorbed from it, by the orifices of the lacteal and meseraic veins. If therefore one of the small intestines be totally divided in its upper part, that is to say, near to the pylorus, the body will then consequently be deprived of its nutriment, and perish by a lingering consumption, when the contents are discharged through the integuments of the wound; but if they are collected in the cavity of the abdomen, and their putrified, death is then much more accelerated.

But wounds of the large intestines, as also of the small ones, very remote from the stomach, with such wounds as do not totally divide the intestinal tube; these, though always dangerous, are yet not absolutely mortal. A madman stabbed himself with a knife in eighteen places of the abdomen, eight of the wounds penetrating into its cavity, a fever soon followed, with a tension of the abdomen, a painful and difficult respiration, sickness at the stomach, vomiting, a diarrhoea, &c. which presaged the event to be fatal; but by repeated phlebotomy, a very thin diet, and seldom dressing of the wounds, the patient escaped beyond expectation. Seventeen months afterwards he went mad again, and flung himself from a high precipice, by which he was instantly killed; and after opening the body, there appeared the scars of the wounds which had been healed; one in the middle lobe of the liver, a second in the jejunum, and a third in the colon (*h*).

One of the small intestines of a large dog being slit open longitudinally, and then returned into the abdomen without sewing it together, the lips of the external wound were then conjoined by future, and the animal did well afterwards, without any bad symptoms supervening (1).

Many instances of the like kind may be met with in the writers of observations, who also furnish us with many accounts of people who have survived after a total division either in the small or large intestines, upon condition that the extremity of the divided intestine be conjoined to the external lips of the wound by future, in order to give an exit to the fæces, as we shall explain more at large in treating of wounds in the abdomen. But in such a case, it is required that the quantity of intestine betwixt the stomach and the wound be long enough to prepare a sufficient quantity of chyle, to be taken up by the lacteal and meseraic veins, as will suffice for the nutrition of the body:

Wounds of the thoracic duct or receptacle of the chyle.] All the chyle absorbed by the lacteals from the intestines, with a vast quantity of lymph returned by the lymphatic veins, is all conveyed through this one tube; which being wounded, and discharging these contained liquors, in that case all the consequences or effects of the chyle, as being mixed with the blood, and farther perfected by the actions of the several viscera and vessels, will consequently cease, that is, nutrition will be destroyed. It is indeed true, that the mouths of the meseraic veins open all round the cavity of the intestines, and absorbing the thinnest part of the chyle, carry it directly to the liver; but the white milky juice of the chyle is received only by the lacteal veins from the intestines; but it is not probable that life can be supported by that thin part of the chyle only, which is taken up by the mesenteric veins, if the rest of the chyle is at the same time prevented from

(1) Philosoph. Transact. Abridg. Tom. V. pag. 272.

from passing into the blood. Dr Lower (k) has demonstrated by several experiments, that none of the gross chyle is absorbed by the meseraic veins. Having opened the right side of the thorax of a dog betwixt the two lower ribs, and by introducing his finger with its nail cut like a saw, he by that means wounded the common receptacle of the chyle, which was then very turgid, being about three hours after feeding; this done, the wound was sewed up, and the animal expired in a few days time, notwithstanding he was constantly supplied with food. Upon opening the body, the stomach and intestines appeared full, and the lacteals turgid with chyle; but in the thoracic duct no chyle appeared, though there was near two pounds of that juice extravasated within that side of the thorax in which the wound was inflicted. In another dog he perforated the left side of the thorax, betwixt the third and fourth of the upper ribs, and then by introducing his finger he lacerated the trunk of the thoracic duct, formed by the union of the two lower branches in this animal, in which the experiment had the like effect as before. But to assure himself that he had lacerated the thoracic duct, after the animal was dead, and the thorax opened, he injected water by a syringe into the chyliferous duct, and the water appeared plainly to run out through the wound into the cavity of the thorax. If a vein be opened, and some blood taken from an animal, a day or two after he has been thus wounded; even though he were well fed but a few hours before, yet there does not appear the least quantity of chyle in his blood, which is always found replete with the milky liquor after feeding, if the passages are entire.

From these experiments it is concluded, that the chyle does not enter the meseraic veins; and that if the course of the chyle to the blood be destroyed, the animal cannot long survive.

I 3

But

(k) De corde, &c. pag. 229, &c. ad 237.

But it very seldom happens in man, that the thoracic duct only is divided by a wound; for it is so placed upon the bodies of the vertebræ, as to lie in the middle between the vena azygos on the right side, and the descending aorta on the left, which last vessel is for a great way incumbent on, or before it: and when it rises up from thence, it continues to ascend upon the bodies of the vertebræ behind the œsophagus, under the arch of the vena azygos, from whence again it inclines towards the left side of the bodies of the vertebræ, and goes on behind the left carotid, 'till it has reached the middle of the lowermost vertebra of the neck; here it forms an arch, incurvated outward and downwards, towards the left arm, in that manner terminating in the left subclavian vein. It is therefore safely secured in all this progress, and the large blood-vessels accompany it all the way, so that it cannot easily be injured without the wound affects the vessels at the same time and then death must be the certain consequence.

Yet have we an instance in Bonetus (1), of a person wounded, by whose symptoms the thoracic duct appeared to be injured. A noble baron was wounded with a bullet about the middle vertebra of his back, the ball passing out under his left scapula. At first the patient was not greatly disordered, having only the usual symptoms of a wound; but about fourteen days afterwards was observed a copious discharge of a white liquor that wetted his linnen, and returned again at intervals, and from whence he grew weak and emaciated, notwithstanding his appetite remained entire. He lived in this condition for several months, and for about a fortnight the discharge had almost ceased; but indulging his appetite, being very passionate, and drinking spirituous liquors, he became subject to epileptic fits, and was afterwards seized with an hemiplegia, or palsy, throughout the left side of his body, of which he expired. After opening the body, the

(1) Sepulchret. f. Anat. Practic. Lib. IV. pag. 306.

the lungs appeared greatly putrified in that part where the wounds had been inflicted.

It is very probable, that the thoracic duct was injured in this case, but not totally divided, since the patient survived so long a time after; and as the said thoracic duct does often divide or ramify into two branches as it ascends, which again unite or inosculate, it is possible that only one of these might be here injured. But after all it must be confessed, that these are only conjectures, since the manner of the patient's death, and the corruption of his lungs, demonstrate that he did not expire only from a wound or injury of the chyliferous duct.

S E C T. CLXXI.

WOUNDS which are in themselves mortal, without they are remedied by art, (152) are:

- I. Wounds of the encephalon, which may be relieved by the trepan.

We come now to another class of wounds, those namely which are certainly mortal if left to themselves; but the fatality of which may be prevented by the known helps of art.

Among these we come first to wounds of the encephalon, which last is a general term, comprehending all the contents of the cranium. It is a thing well known by Anatomists and Physicians, that the cavity of the scull is naturally most exactly filled: and whenever then the cavity thereof is diminished either by changing its figure, or by the extravasation of the juices from the ruptured vessels within the cranium entire, the soft substance of the encephalon will from thence consequently be compressed, so as to injure all the functions depending thereon, and at length totally destroy them.

If now the cranium be depressed, or the encephalon compressed by the quantity of extravasated juices; or finally, if the soft pulpy substance be corrupted by the acrimony of the putrified and stagnant juices, death must consequently be the effect of such a wound, because all the animal and vital actions result from the parts injured. But if the extravasated juices are lodged in such a part of the cranium as will admit of applying the trepan, to make an aperture for their discharge, in that case it is evident, that the wounded patient may be preserved: and we shall, in treating of wounds in the head, enumerate several observations of men who have become apoplectic from the pressure of the brain, by the extravasated juices, and who have recovered after they have been discharged by the trepan.

Two things are therefore required in these wounds, namely, that the compressing cause be evident, so as to point out the seat of the extravasated juices pressing upon the encephalon: and, 2. that they be seated in such a part, as will admit discharging them by the trepan.

2. Wounds of the larger arteries and veins, so seated, that the hand of the Surgeon can have no access to them.

It is highly necessary for a Surgeon to be well acquainted with the course of the larger arteries and veins, especially those of the limbs: for such of the large trunks as are seated within the cavities of the body, are not capable of being relieved by the hand, whenever they are wounded. It is more especially necessary for him to know in what parts of the limbs the large arteries and veins lie so naked, that they may be easily compressed, such as the armpits in the upper limbs, the anterior and upper part of the humerus, where the large arterial trunk may be compressed against the subjacent bone, and by that means

the hæmorrhage from any wound inflicted in the parts below the compressure, may be easily stopt or restrained. In the lower limbs they lie most bare and fit for compressure, in the interior and fore-part near the middle of the thigh, as also in the hams. By applying compressure to these parts, and the fixing over them the instrument called a tourniquet, the trunks of these vessels may be so clearly compressed, as to prevent any blood from passing through them, by which means a fatal hæmorrhage is prevented, and an opportunity given to the Surgeon to perform his office of dilating the wound, if necessary, in order to discover the divided artery secured by ligature, and apply the proper dressing, &c. Hence there does not seem to be any wound of the extremities that can be justly termed mortal in our day, at least not absolutely so, because we are acquainted with the art of compressing the sanguiferous trunks as they pass through the groins and armpits; and if an artery that is wounded lies so deeply seated within the limb, that it cannot be secured by ligature, the patient's life may even then be preserved by amputation. But when a Surgeon is ignorant of the course of the larger blood-vessels, then all his endeavours to restrain the hæmorrhage by ligatures, styptic powders, &c. only prevent the blood from escaping through the orifice of the wound, but being confined within its cavity, is afterwards forced into the cells of the adipose membrane, whence follows a frightful corruption or putrefaction of that body, as we are assured by woful experience.

3. Wounds of the viscera, to which neither the hand nor remedies can be applied to effect a cure.

Who would believe that part of the vital viscera might be amputated, when they are exposed by wounds, if it was not proved to be safe by experience,

in order to prevent their corruption to the hazard of the patient's life. Formerly Celsus (a) boldly pronounced, *Si quid aut ex jecinore, aut pulmone duntaxat extremo dependeat, id præcidatur*: "That if any part of the liver or lungs should hang out of the wound only by a little bit, that may be cut off." It will be sufficient for our purpose to remark only one notable instance, by which it may appear that such wounds may be frequently cured by the assistance of the hand, which are otherwise in themselves mortal. A man received a large wound under his left nipple, but being afraid of the Surgeon's hands, he neglected the wound, and the day afterwards part of the lungs protruded through the wound to the breadth of three fingers, yet the rash man altogether neglected so dangerous a wound; nor did he use any application, though he was two days upon the road to Amsterdam, where he was taken into the hospital; there the mortified part of the lungs was immediately secured by ligatures, and then cut off with a pair of scissors, to the quantity of about three ounces by weight. In fourteen days time the wound was healed, without any other disorder remaining than a slight cough; it was not always troublesome, but only at times. In this manner he survived for six years afterwards, falling into all parts, indulging himself with drunkenness and a dissolute course of life. Upon opening the body, no other disorder appeared but an adhesion of the lungs to the part wounded, which occasioned that slight, and sometimes troublesome cough (b).

In the fifth number of the preceding section we mentioned two cases, where the stomach had been greatly wounded, but was afterwards conjoined with future by the hand of a skilful Surgeon, who completed the cure. And it will evidently appear, when we come to treat of wounds in the abdomen, that many of the abdominal viscera are often so wounded,

as

(a) Lib. V. cap. 26. No. 24. in fine, pag. 295.

(b) Tulpæ Observat. Med. Lib. II. Observ. 17. pag. 125.

to destroy the patient by discharging their blood, other contents into the cavity of the peritonæum, unless prevented by ligature, or stitching to the margin of the wound, &c.

Such wounds of the viscera as prove mortal, by extravasating their contained liquors into some cavity, from whence they may be extracted without hazarding life; such as those of the thorax, abdomen, ureters, bladder, and some wounds of the intestines.

Many wounds are mortal, not from the quantity of blood lost, but from its being retained and putrified after extravasation, by the warmth of the parts, so that it corrodes the viscera, and destroys the nutrition; thus, for example, in a wound of the thorax, after a profuse hæmorrhage, the wounded patient recovers from his deliquium, the divided vessels contract themselves, and the flux of blood totally ceases; but in the mean time, that which was extravasated in the cavity of the thorax, putrifies and infects the adjacent lungs, with a vomica or ulcer, whence the patient is destroyed by a lingering consumption. The same is also true with regard to the cavity of the abdomen, but then we may perform the paracentesis both in that and in the thorax, so as to discharge the extravasated blood, and prevent all the fatal consequences. But if the fundus of the bladder or uterus are so wounded, that the urine escapes into the cavity of the abdomen, it is evident from the great propensity of that liquor to putrefaction, that it will corrupt much sooner, and therefore greatly injure all the abdominal viscera; but here again all the extravasated liquor may be extracted from the abdomen by the paracentesis, and by introducing a flexible catheter into the bladder, and leaving it there, no urine will then be suffered to gather and distend the bladder, which

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constantly remaining contracted, the wound will have a better opportunity to unite and heal. But if one of the ureters is divided, after discharging the urine from the cavity of the abdomen, and then by using a very dry course of aliment, there is then great hopes that the extremity of the divided ureter will collapse and close; thus indeed the use of the kidney will be lost but then we are taught from many instances, that the other kidney will be sufficient to secrete the urine, and sufficient to preserve the body in a healthy state. For we have known several patients, where the cavity of an ureter has been totally obstructed by a stone impacted, and yet the patient has survived many years the other kidney performing the office of both, it being generally found much larger than usual.

But we know that the urine escapes into the cavity of the abdomen from the seat of the wound, and from the patient's making little or no water, as also from the tumour of the abdomen, which daily increases.

The same is applicable also to wounds of the intestines, which we shall consider in treating of wounds in the abdomen.

S E C T. CLXXII.

THAT a curable wound will become mortal, (153) is foretold from the following causes:

1. A neglect in cleansing or discharging the stagnant matter, or the extravasated blood tending to putrefaction, whence follows a purulent tabes.

In this class are comprehended those wounds which injure such parts of the body, whose integrity is not absolutely necessary to life, or which may be wounded and life remain; though death frequently follows after such wounds, not so much from the wound itself,

Self, as from the injury offered to the vital functions, either from the neglect of the patient, and ignorance or error of the Surgeon, a bad constitution, or from some other malady. These wounds may be commodiously reduced to the four following heads.

A neglect of discharging the stagnant matter, whence a purulent tabes.] It is apparent from what has been said, §. 158. Numb. 7. that in every considerable wound there is matter formed, and that the formation of this matter is necessary, in order to separate every thing which may impede the consolidation of the wound. If then a wound be such as to discharge its matter into some cavity of the body, or if its matter be left too long within the wound itself, so as to be attenuated and absorbed by the patent orifices of the veins, it may then infect the whole mass of blood, so as to produce a hectic fever, with a lingering consumption. But if it is evident, that the matter contained in any cavity of the body may be safely discharged from thence, without any dangerous consequences, or if the return of the matter into the blood might be prevented, by duly cleansing the wound, it is then evident, that the death of the patient is to be ascribed not to the wound, or the cause, but to the neglect of cleansing it from the matter, &c. After the extirpation of large limbs, very often the daily discharge of matter is so great, as to occasion no small difficulty in the cure of the wound; for if it be cleansed several times in a day from the matter, that will impede the healing of the wound, which then degenerates into a sort of issue, running an incredible quantity of thin matter, so as to consume the patient with a true marasmus, without any other defect either in the solids or fluids; only because the quantity of matter discharged from the wound being too great, it drains off so much of the nutritious juices, that the other parts are starved. But if the wound remains undressed a considerable time, the matter retained upon the superficies of the wound becomes attenuated and acrimonious,

nious, by the warmth and stagnation, so as to be absorbed by the open orifices of the veins, whence mixing with the blood, it there produces a purulent cachochymy and consumption, or else proves destructive, by settling upon some of the noble viscera, of which there are many examples that frequently occur in practice.

Or if blood be extravasated and putrified.] Hippocrates says (c), *Si in ventrem sanguis effusus fuerit præter naturam, necesse est suppurari*: “If the blood be preternaturally extravasated within the cavity of the abdomen, it must necessarily putrify.” Galen, in his commentaries to this aphorism, takes notice, that it ought to be read *ἐς κοιλίην* instead of *ἐς τὴν κοιλίην*, and then, by leaving out the article, it will signify blood extravasated in any cavity. He also adds, that he is the more confirmed in this opinion, from the words *præter naturam* following, and then the sense of this aphorism will be, that blood extravasated in any cavity of the body, must suppurate or putrify. Galen also advertises us in the same place, that by the word suppuration we are to understand here, not only the conversion of blood into laudible matter, but any corruption thereof. If blood be extravasated into some cavity of the body, and a free access be given to the external air, the blood will then quickly putrify, and corrode the adjacent viscera; or else, being absorbed it will by its acrimony destroy the tender vessels and viscera, so as to bring on death: but if the air be not admitted, the blood will then stand a long time without corrupting, and being gradually attenuated, it will frequently be returned again without any manner of corruption, as we frequently see in violent contusions where the blood appears discharged from the broken vessels under the skin, and often continues there for above a month, and will afterwards gradually disappear without any farther damage. Whenever then the blood is extravasated into any cavity of the body

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and a free access of the air be granted at the same time, death is the consequence, and is to be ascribed to this cause, whenever the wound appears to have been not mortal in its own nature, that is, when the extravasated blood might have been safely discharged by art.

2. By errors committed in the six non-naturals.

It is well known from the writers of pathology, that the non-naturals are divided into six classes, viz. air, meat and drink, motion and rest, passions of the mind, excretions and retentions, sleep and vigilance, which are thus called, because by misusing or abusing them, they may become destructive to nature, notwithstanding they are in themselves things good and natural. A prudent Physician regulates all these by forbidding and restraining the patient from what will prove hurtful. But if by the negligence of the Physician, or obstinacy of the patient, errors are committed in the six non-naturals, a wound may by that means become mortal, though it was not so in its own nature. We are furnished with innumerable observations by practical authors, plainly proving this assertion; but it may be sufficient for our purpose to remark only a few.

When Parey (*b*) attended the wounded soldiers in the camps, it was a very great concern to him that the wounds bled afresh at every explosion of the cannons, by which means those especially were injured who had received wounds in the head; whence all the symptoms were increased, and death accelerated. A lad of fourteen years old fractured one of the ossa parietalia, many fragments were extracted, and the fever, pain, and other symptoms, were gone off, so that there were great hopes of a compleat cure: but the father of the lad, though he was strictly forbid by the Surgeon to permit any disturbance, did, notwithstanding, suffer the

(*b*) Les Oeuvres de Ambroise Paré, Liv. X. chap. 14. pag. 231.

the country folks to sing, drum, whistle and dance, &c. in the way of rejoicing, near the patient's chamber; but the day after the unhappy lad was taken with an acute fever, delirium, vomiting and convulsions, and on the fourth day expired (c); for which the father was severely fined, after the affair came to the ears of the magistrate. In another case of the like nature, when every thing seemed well, a fortnight after the wound was inflicted in the head, the lad being suddenly put into a passion, was seized with an acute fever, and died delirious on the fourth day after (d).

The left-hand of a certain nobleman being amputated by an eminent surgeon, and the wound almost healed, the Surgeon forbid him from lying with his wife; who being advised by the Surgeon, refused to comply with him; whereupon the wounded patient, *sine coitu semen emisit*; but he immediately fell into a fever followed with a delirium, convulsions, and other bad symptoms, of which he expired on the fourth day (e). From these observations it is sufficiently evident, with how much caution those patients ought to be treated, who are dangerously wounded; and how strictly they ought to be advised to obedience, unless they will pay for their rashness at the expence of their lives.

3, By the neglect or error of the Surgeon.

We are taught by many observations, as well as by daily experience, that contusions and slight wounds of the head being treated with neglect, have brought on the most melancholy symptoms, and even death itself. How many have perished by hæmorrhages, who might have been saved by compressing the trunk of the artery with a convenient apparatus in that part where it lay most exposed! What numbers of the wounded have perished after a battle, which the Surgeons

(c) Hildan. Observ. Chirurg. Cent. 1. Observat. 20. pag. 25.

(d) Ibid. Observat. 17.

(e) Ibid. Observat. 25.

geons being overloaded by the multitude, have treated each with too much neglect! Nor does the patient often receive less damage from the ignorance or error of the operator. A soldier received a large wound under his breast, which was attended with a cough and spitting of blood; the ignorant Surgeon in this case sewed the lips of the wound together; but the day following Parey was called, who found the patient in a high fever, with his respiration and speech much impaired, so that there was great reason to fear his death was at hand; but he immediately cut open the suture, and by introducing his finger through the wound, removed the concreted blood that obstructed its orifice; then by elevating the patient's feet, and depressing his head, his mouth and nose being at the same time shut, he by that means extracted eight ounces of corrupt and fetid blood from the cavity of the thorax, which he afterwards cleansed from the remaining fordes by injections; and thus the patient recovered beyond expectation from his wound, by which he would otherwise have certainly perished through the ignorant and bad treatment of the other Surgeon (f). What frightful symptoms have sometimes followed from the application of sharp caustics, to tendinous and membranous parts. Hildanus (g) extirpated a wart or tubercle from the end of the right thumb in a barber-surgeon; but the ignorant fellow persuading himself that the root of it was not sufficiently removed, applied some arsenic to the green wound, which was soon after followed with great pain, fever, restlessness, anxiety, and faintings, insomuch that his life was greatly in danger; yet he escaped, and at the hazard of his own life learned to be more cautious in the treatment of others. The same author gives us another instance of death following the imprudent application of arsenic to a cancerous tumour, seated upon the wrist of a robust and middle aged

(f) Les Oeuvres d' Ambroise Paré, Liv. X. chap. 32. pag. 251.

(g) Hildani Observ. Chirurg. Centur. VI. Observ. 80. pag. 607.

Helvetian. But accidents of this kind have happened not only to ignorant artists, but also the most experienced have sometimes lamented their past mistakes, as may appear even from the example of Hippocrates (*h*), who ingenuously confesses himself to have been deceived in mistaking a fissure in a bone of the skull, for a future in a wound of the head, which occasioned him to think that the patient did not require trephination, which being performed too late, the patient expired on the sixth day. If the chief of Physicians could be thus mistaken, every one will think himself also liable to error, which we can only use our best endeavours prudently to avoid. But if an error of this kind be discovered in the practice of a Physician or Surgeon, equity will sometimes reveal it to the Judge, lest the person who inflicted the wound should pay, at his own expence, for what followed from the error of another.

4. By the natural or morbid constitution of the patient, either apparent from the history of the patient himself, or which is sometimes so latent and extraordinary, as not to discover itself but by the particular event. This is a circumstance that ought carefully to be observed, when a Surgeon or Physician is ordered to make his report to the Judge.

It is a thing of the utmost consequence in making the report of a wound, to attend to the particular habit of the person wounded, which is yet a circumstance often altogether neglected. In many cities, certain Physicians and Surgeons are appointed by publick authority to inspect the bodies of such as have been killed, and to report their observations to the Judges: but these very often neglect to consult the Physician
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(*h*) Hippocr. Epid. lib. V. No. 22. Charter. Tom. IX. pag. 340, 341.

or Surgeon who attended the patient, that they may from them learn what symptoms followed from the wound itself, and what from the patient's habit, or preceding disorders, &c. all which ought to be particularly regarded in making a faithful report of a wound. For there are many people who have their whole nervous system so very liable to irritation, that the slightest cause throws them into convulsions, cramps, &c. while others again faint away even at the sight of blood, though from the wound of another. But does it not seem very probable, that even a slight wound in such a person may induce the most violent symptoms, or even death itself? Or whether the patient's death, in such a case, ought to be ascribed only to the wound as the cause? The king of Persia playing with one of his concubines that he had a great love for, directed the point of his dagger towards her breast, and while he was feigning to stab her naked breast, happened to make a slight wound, scarce visible to the eye, and yet she suddenly fell down and expired in an instant (*i*). It must be also considered, that in some diseases toward the period of life, there is but very little blood in the body, inasmuch that after a patient has expired of a consumption, there are but a few ounces of blood to be found; and if such a person should lose a few ounces by a slight wound, death would certainly follow, but not from the wound only. It is well known, that in venereal disorders, and scorbutic habits, the most compact substance of the bones are so corroded, and rendered carious, that they break with the least force; but if the skull should be fractured by a slight blow in such a person, so as to prove mortal, the cause of the patient's death would not be by the blow only, &c. But these, and such-like circumstances, can be wholly known from the patient himself, or those who have been acquainted with his course of life and disorders. If we peruse the observations made upon bodies that have died suddenly, we shall often

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find

(i) Amœnit. exoticar. Engelbert Kæmpfer, pag. 59.

find that death has proceeded from the most latent causes, when at the same time nothing appeared in the patient's health capable of producing death; but if such a person should be wounded a little before he expired, his death would be rashly attributed to the late wound, though it resulted from very different causes. (k) *Fine namque vitæ nostræ variis & occultis causis expósito, interdum quædam immerentia supremi fati titulum occupant: cum magis in tempus mortis incidunt, quam ipsam mortem accersant:* " For the end of
 " our life, which is exposed to various and latent in-
 " fults, and sometimes several fatal incidents, are sup-
 " posed to be the cause of death, when they are ra-
 " ther incidents in the time of death, than causes
 " thereof." Hence therefore a report ought to be made to the Judge in such cases, that the wound appeared to be only of such a condition, that the patient's death could not follow probably from thence as the cause; and thus ought the Surgeon or Physician to acquit himself, leaving the rest to the Judges.

S E C T. CLXXIII.

FROM hence the reports of wounds, and the limitation of the time in which they will be known to prove mortal or not, may be determined.

Before the Judges usually inflict a penalty upon the offender, they generally commission a Surgeon or Physician to enquire into the body of the deceased, and to report, whether the wound was the cause of his death. It is therefore the business of these latter, to observe carefully what parts of the body appear injured by the wound, and then by their consent to determine whether the wound was absolutely mortal, or whether it was so only in its own nature, but might have

(k) Valer. Max. Lib. IX. cap. 12.

have received a cure by the artifices at present known in the profession. Lastly, they are to remark whether the wound has injured such parts as are not absolutely required to be sound for the continuance of life, but have only proved mortal, either by the neglect or habit of the patient, or the error of those who had the care of the wound, &c. all which ought to be given in writing to the Judge, and is called the report of a wound. From hence it is apparent, how much caution is necessary in examining wounded bodies, since unskilful Surgeons, very often, rather make than examine wounds. Enquiry ought to be made as much as possible, concerning the figure and magnitude of the wounding instrument, as also the posture of the wounder and the wounded, when the injury was inflicted, together with all the symptoms which have followed from the first infliction of the wound, to the death of the patient.

Every thing ought also to be considered which has happened to the patient by his treatment, after the wound inflicted. And lastly, a search ought to be made how far, and through what parts, the wounding instrument has penetrated; that from a knowledge of the uses of the parts injured, an inference may be drawn, whether the patient's death ought to be ascribed to the wound or not, as the cause.

But it seems to be no easy matter, to determine the space of time within the limits of which the wound may be allowed to be mortal. The general opinion is, that if the patient survives nine days, his death happening after, cannot be attributed to the wound, which, on the contrary, if he expires within that time, must be allowed the absolute and necessary cause of his decease. But a large artery divided either in the leg or arm, may kill the patient in a few minutes, when at the same time the wound was not absolutely mortal in itself, but might have been cured by art. And so if blood be extravasated in the cranium, in such a part as will not admit of extracting it, though

134 Of WOUNDS in general. Sect. 174.
its quantity be so small as not immediately to disturb all the functions of the encephalon, yet by stagnating and corrupting there, in process of time it may so corrode and destroy the brain, cerebellum, and medulla oblongata, as to occasion death; and such a wound may be justly reported mortal, notwithstanding the patient may continue long. If one of the smaller intestines be totally divided, not very near the pylorus, the patient may survive, and in that case live a considerable time, even 'till the whole habit is consumed or wasted by the defect of nourishment, and yet such a wound is absolutely mortal. From hence it is evident, that nothing certain can be determined with regard to limiting the time in which a wound may prove mortal.

S E C T. CLXXIV.

ALSO from the history of a wound (145 to 173) one may easily foretel the consequent events, which are deducible from the prognosis (169).

In §. 169. was considered the prognosis of wounds. We there determined what events might be foreknown to follow as consequences from a known wound. We have spoke concerning the patient's death or recovery, in §. 170, 172, 173, and as to what regards the cure of the wound being practicable or not, easy or difficult, or what defects may remain after its cure, these may be plainly deduced from a right understanding of the nature of the wound. For when a Surgeon or Physician is acquainted with the parts of the body and their functions, he may then discover the parts injured by their actions depraved or abolished, and may thence determine whether the cure is practicable or not, easy or difficult, or whether any, and what defect will remain in their actions or uses, after the cure of the wound is compleated. For example, if a wound be
inflicted

inflicted on the back of the hand, the Physician knows from anatomy, that the tendons of the extensor muscles of the fingers are there seated, and by ordering the patient to extend his fingers, he will then see, that if the fore-finger is not drawn quite back even with the rest, its tendon of the common extensor muscle must be divided; if then it appears, that the ends of the divided tendon may be approximated, and brought to each other again, he may then promise that the cure will be compleat though difficult. But if he finds the re-union impracticable, he may then safely predict that the fore-finger will lose its power of extension after the cure, and that it can never be recovered again by any art or application. In such like presages it behoves a Physician or Surgeon to be very cautious and particular, because the disorders which remain after the cure, may otherwise be attributed to his error or neglect, which he may thus prevent, by saying, such or such accidents will certainly follow, or are at least to be feared, after the cure.

S E C T. CLXXV.

BUT the causes of the phænomena in wounds (158 and 159), will appear evident to one who is skilled in the animal and vital actions of the body. See what has been said before on diseases of the solids and fluids in general,

The several particulars of the sections here cited have been explained, each in their proper places, and therefore we shall here only make a brief recapitulation of them. 1. It is evident, that by the continued action of the power by which the soft parts cohere, the divided lips of the wound will be each drawn back, so as to form an hiatus or opening, which will be the larger as the cohesion of the parts was before stronger; and hence the lips of wounds always recede the most

from each other in strong and laborious persons. 2. The power that distends the vessels diminishing, from the free reflux of the blood from those wounded, the proper contractile force of the vessels will then prevail by degrees, 'till they are perfectly closed. 3. From the nature of the blood being such as to concrete after extravasation and stagnation, from hence, with a dissipation of the more fluid parts, the extravasated blood will form a crust or covering over the mouth of the wound. 4. The mouths of the divided vessels contract, and retain the thicker parts of their juices, while the more thin and fluid still continue to run out; from hence that dilute or thin and reddish coloured liquor that follows after the hæmorrhage has ceased. 5. But when the divided blood-vessels are so far contracted, as no longer to discharge any of the red blood, the flux continues notwithstanding in the serous, lymphatic, and smaller series of vessels, from whence arises an obstruction of those vessels; and the blood being urged on forcibly from the heart, against the extremities of the obstructed vessels, occasions them to dilate, and produces all the consequent symptoms, as pain, inflammation, &c. In the mean time the lax substance of the membrana adiposa being pressed by the contracting skin, arises up from the bottom of the wound, so as to project through and dilate the lips thereof. 6. But if the wound was considerable, a slight fever will arise from the pain and inflammation about its bottom and sides, which fever is by Surgeons denominated vulnerary or suppuratory; and if not violent, is always a good presage. 7. During this fever, the lips and bottom of the wound, before dry and inflamed, begin to grow moist, and discharge a thin liquor, which is by stagnation and the warmth of the part exhaling its most fluid substance, called pus or matter. 8. At the same time the extremities or mouths of the inflamed vessels are suppurated, together with their impervious juices; and being intimately mixed, constitute part of the matter, so that
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the vessels being again opened, or else those which are obstructed being suppurated and discharged, the circulating juices are restored to their free course, and the heat, pain, tumour, &c. are consequently removed, or greatly diminished. 9. Matter being thus discharged by suppuration from the bottom and lips of the wound, nature, who is self-sufficient, then begins to extend the extremities of the vessels from the bottom upwards; and from the sides towards the center, where meeting with others, they restore the loss of substance, which was before made in the part wounded. 10. The margin of the wound, finally, begins to look of a whitish blue colour, and by drying forms a cicatrix, which daily increases from the whole circumference towards the center, 'till it has closed the wound, the cure of which is then compleated.

S E C T. CLXXVI.

THE external coats of the arteries being either punctured, cut, contused, overstretched, or eroded, the internal coats remaining uninjured, are then by the impetus of the blood dilated, so as to form a sacculus, which frequently increases to the size of an egg, the sides of it become callous, and beat with a pulsation or diastole; the whole tumour looks red and shines, and being compressed disappears, but returns again after the pressure is removed; its own artery becomes much enlarged, and by compressing the adjacent arteries it obstructs them. This tumour is called an aneurism (160), the causes, signs, and effects of which are evident. Hitherto we also refer aneurisms of the heart, with their causes, signs, and effects.

We have said, in §. 159 and 160, what the disorders are which follow a total division of an artery; or wound which only penetrates into the artery without totally dividing it; but in this place we are to consider the symptoms which are to be feared from a wound of an artery not penetrating into its cavity, but only dividing its exterior coats. It appears from anatomy, that the arteries, especially the larger, have pretty thick coats, the outermost of which is generally a continuation of the common membrane, lining the cavity through which the arteries pass, to which membrane the thin cellular one is subjacent, through whose substance a great many small vessels are spread for the nutrition of the artery itself. Under the cellular tunic is supposed to be a glandular one, which is perhaps, only a part of the former; then comes the thick and strong muscular coat, consisting of orbicular fibres, and divisible into several lamellæ. Lastly the coat investing the internal cavity of the artery consists of longitudinal fibres.

While the blood is impelled by the force of the heart into the arteries, which are always full, it is observed to distend or dilate them sensibly and equally throughout; now the firmness of the coats constituting the artery, restrains this dilatation from being too great; and when the force of the heart ceases, the artery is again contracted, chiefly by the action of the orbicular fibres, into its former dimensions. If then the strength of the sides of an artery is diminished by a wound in its orbicular fibres, (for injuries of the external and cellular coat seem to be less dangerous) the power distending the artery remaining the same in the part injured, as in those which are entire, will consequently dilate the artery most in the injured part, so as to change the equable and conical figure of that vessel, by distending its weakest part into a sacculus; and this tumour is properly termed a true aneurism, which signifies literally no more than a dilatation of the artery.

The cause therefore of an aneurism is every thing which destroys the cohesinn, or diminishes the force of the coats of an artery in any part: and experience teaches, that this generally happens when an artery is either cut or punctured, which are accidents but too frequent. For in opening a vein, the point of the lancet sometimes wounds a branch of the adjacent artery at the same time; and in a few days after a tumour begins to appear above the skin, daily increasing, and having a manifest pulsation, unless it be timely prevented at first with a fitting apparatus of compress and bandage.

Contused.] To give an instance, that a violent contusion of an artery may produce an aneurism, we shall mention the case of a strong healthy man of forty-five years old, who passing along the publick streets, was accidentally struck on the left side of his back with a ball of box-wood; after returning home, the part injured was carefully examined, but nothing more appeared than the signs of a contusion; and thus he continued for the space of four years, with only a slight uneasiness in the part injured. After so long an interval of time he began to complain of a violent pulsation in the same part, which increased daily, and corresponded with the contraction of the heart; and for some months the patient suffered extreme anguish, his ribs being elevated and corroded. An impudent quack having persuaded him, that it was a deep abscess, he therefore made an incision, and the blood flowed from thence like a torrent, so that he instantly expired (a). I remember myself to have seen a case, where an aneurism arose from a bare contusion. A man of a short stature walking in the dusk of the evening, hit his right breast a violent blow against a post, which was followed with an acute pain for some time in the upper part of the thorax, but it afterwards went off. After some months the patient began to perceive an unusual pulsation under the right clavicle,

(a) Lancisius de motu cordis & aneurismatibus, pag. 235.

clavicle, which daily increased; the patient was out of breath after the least motion, and was toward the period of his life in a manner suffocated, so that after languishing in this condition for about a year, he expired. I observed in the body, that the right subclavian artery was vastly dilated into a sacculus, insomuch that the coats of this aneurism were not thicker than writing paper, and being pellucid, the contained blood was visible through them: upon making a slight incision in the tumour, it discharged a large quantity of concremented blood.

Overstretched.] We meet with many observations among practical writers, of arteries which have degenerated into aneurisms, by an overstretching of the coats in violent straining, to lift great weights, in sneezing, violent coughing, &c. A man in hunting suddenly bent his head on one side, and could not put it back again but with the greatest difficulty; from that time he grew weak, and was much impaired in his respiration and deglutition, so that in the space of fifteen months he died (b). Upon opening the body the aorta was found vastly dilated, and a large sacculus or aneurism appeared in the right subclavian artery. Those horses which are obliged to draw heavy carriages with great weights, ascending over steep hills and bridges, being shod with rough iron shoes, are often obliged to strain so violently, that it is not uncommon thing to meet with aneurisms of the arteries, and varices of the veins in their hinder legs. The like tumours are also frequently observable in the limbs of porters.

Eroded.] We know that in diseases the juices may degenerate and become so acrimonious, as to corrode even the most compact parts of the body: thus the hard teeth are consumed in a scurvy; and the most firm and large bones are rendered soft and carious in the venereal disease: also the corroding matter of a cancer eats away all the parts in its reach. We even
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(b) Acad. des Sciences l'an 1700. Hist. pag. 50.

sometimes find in a scurvy, that the coats of the vessels being eroded, they extravasate their blood in livid spots under the skin, and sometimes fatal hæmorrhages have been thence remarked by authors. Hence one may easily conceive, that the coats of the large arteries may be so eroded, as to make them dilate into a sacculus or aneurism. We have two instances of this nature given us by Lancissi (c), where the clavicle being encircled with a venereal tumour, adhered to the adjacent subclavian artery, whose coats were eroded and extended into an aneurism.

When from any of the forementioned causes an artery is weakened more in one part than another, the weakest place will yield to the distending force of the blood, and be dilated more than the rest: and as the distending cause is repeated or applied afresh to the weakened part, every time the heart contracts, therefore the capacity of the aneurism will be gradually increasing, till it is expanded sometimes to an immense bulk, especially when seated in the large trunks. Thus we are told by Ruysch (d), that he saw a man with an aneurism in the thorax, that came of itself, which was so large, as to equal a common cushion upon which we sit, supposing it to be round, or without corners, like a tumour. In the body of this patient the aorta appeared to have dilated to this enormous bulk about three fingers breadth above the heart. It is observable, that in large aneurisms, the coats or membranes have been often found very thick, when one would rather think or expect to find a dilated membrane thinner. This circumstance seems to arise from the congealed blood adhering to the sides of the tumour, where it by degrees hardens and turns to fleshy substance; and accordingly Ruysch observed, that in a large aneurism, that there was a great number of thick, tough, and fleshy coats, one within the other, having some blood lodged betwixt them; whereas

(c) De motu & aneurismatibus, pag 256.

(d) Observ. Anatom. Chirurg. Centur. Observat. 38.

whereas the external coats, only formed by a dilatation of the membrane of the aorta, was no thicker than straw, the thickness of all the other membranes arising from the polypous concretions.

But it may be reasonably asked, by what signs may an aneurism be known and distinguished from other tumours? since we are taught by many observations that several, in other respects, skilful Surgeons, have imprudently destroyed their patients by opening the tumour. An aneurism may be known, from the foregoing causes having preceded, from the tumour being seated in a part where we know from anatomy there is some large artery seated, but more especially when it has a manifest pulsation sensible to the touch and if the tumour disappears, or greatly diminishes by a slight pressure, and returns again when the pressure is removed. But it must be observed, that the colour of the skin is seldom changed by an aneurism, unless it is very large and of old standing, and then the skin being eroded or stretched so as to become very thin appears of a red colour. The pulsation also of an aneurism is at first but small, and is sometimes not perceived, even when it is grown to a considerable bulk and this partly from the coats of the aneurism becoming thicker, and partly because the impulse of the blood sent from the heart cannot act so strongly on the sides of a large aneurism, to dilate them at each systole. But in compressing an aneurism, especially on that is large and near the heart, the patient will be in great danger of sudden suffocation, unless it be done very gently and gradually; for the concreted blood returned out of the sacculus of the aneurism, gives a great resistance to the blood in the aorta from the heart, as to destroy the motion of this last very suddenly: or if a large aneurism be compressed by the hand, the pressure must not be taken off all at once but by degrees, otherwise the patient faints, from the sudden return of the blood into the cavity of the sacculus; and therefore the patient always complains of a

intolerable

tolerable anguish or oppression in the thorax, when a large aneurism is thus compressed. But when any aneurism lies concealed in some of the viscera, or more internal parts, it is much more difficult to discover: but if the known causes of an aneurism have preceded, the patient perceives an unusual pulsation, the heart palpitates, or is disturbed in its motion, and suffocation almost follows from quickening the blood's motion, either by exercise, or any other cause; from these circumstances it will appear very probable, that an aneurism must be concealed in some internal part of the body.

The disorders produced by an aneurism arise from hence, that the tumour compresses the adjacent vessels, and disturbs their actions, changes the figure of the artery, and thereby destroys the equable circulation of the blood, and at length greatly impedes the action of the heart itself. From hence it appears, that very different disorders may arise from an aneurism; but that all the symptoms thence proceeding, are constantly worse, in proportion as the aneurism is large, and situated nearer to the heart.

Another spring of the disorders following an aneurism, is the degeneration or morbid change which the blood receives, by being stopt in the sacculus of the aneurism, where it will either stagnate, or at least move slowly; whence it will be less warm, and consequently disposed to produce all the disorders which arise from a diminution of the blood's heat and motion. Thus polypous concretions will be formed, which uniting with one another as the blood passes, will greatly augment the mass or polypus in the aneurism, as we before observed (§. 52. numb. 2.) Whence upon opening large aneurisms, they have been often found wonderfully distended, not with much blood, but with an extraordinary kind of polypous or fleshy substance, formed by the stagnant blood adhering to the sides of the weakened artery, which instead of being burst, is thereby rendered so firm, as to prolong

long the patient's life. But in process of time, the concremented blood, with that stagnating betwixt the lamellæ of the polypous substance, begins to corrupt and becomes so acrimonious, as to corrode the adjacent vessels, membranes, cartilages, and even the compact bones. The writers of observations are full of such accounts; and Ruyfch observes, in the place a little before cited, that almost all the ribs and sternum of the patient, who had the large aneurism, were reduced nearly to nothing. But while the corrupt blood stagnating in the sacculus of the aneurism is returned through the whole habit, it brings on a putrid caco-chymy, followed with a hectic fever, by which the whole body is slowly wasted. And that large aneurisms destroy the patient in this manner, is evident from observations and experience; unless the patient dies before the caco-chymy be produced, either by suffocation, or a rupture of the aneurism.

But there is danger of sudden death from the rupture of such an aneurismatic sacculus, and a patient sometimes expires thereby in a moment, when the cause is little thought of, as we have a remarkable instance. (e) A soldier, after a violent fit of coughing, had a tumour formed in the lower and forepart of his neck, immediately above the margin of the sternum. the tumour was soft, round, and without any alteration of colour in the skin; it had a pulsation, and yielded to the pressure of the finger, returning again when the pressure was removed. He sustained this large aneurism for the space of six weeks, when on a sudden a flux of blood burst forth from his mouth, of which he expired in a minute's time. The tumour in his neck vanished after death, and was found to be an aneurism adhering to the trachea, into which it had an opening betwixt the sixth and seventh cartilage, by which passage the blood escaped into the windpipe and out at the mouth.

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(e) Académ. des Sciences l'an. 1733. Memoires, pag. 153.

Since aneurisms in the internal parts of the body are inaccessible to the hand, there is but small hopes of cure; and all that can be done for the patient, is to abate the impetus and velocity of the blood's circulation by a thin diet, and repeated phlebotomy, by which the aneurism may be prevented from increasing, as much as possible, provided the patient be ordered to refrain from all commotions both of body and mind, for the same reasons. When the aneurism is accessible to the hand, and not yet increased to any formidable size, there may be some hopes of relieving it by a prudent compressure, in making of which it will be also of no small service to keep a moderate pressure upon the artery above the aneurism, to abate the impetus of the blood, and prevent it from easily regurgitating back towards the heart. When we can hope for little or no benefit by compressure, or when it has proved ineffectual, there is then only the operation remains of extirpating the aneurism, the safety and success of which we are taught by experience. Even Ruisch (*f*) relates a case where the operation happily succeeded, though the arm was already seized with a gangrene.

Hitherto we also refer aneurisms of the heart, with their causes, signs, and effects.] An aneurism of the heart is a preternatural enlargement of its cavities, which is a disorder that pretty often occurs, though it be not so much remarked, nor well described. It is easily conceivable, that the heart is liable to all the same accidents which produced aneurisms in the arteries, viz. a destruction or weakness of the external coats by wounds, contusions, distensions, erosions, &c. The observations from practical anatomy convince us, that in the heart has been found inflammations, wounds, suppurations, erosions, &c. A sailor was seized, after a continual fever, with a spitting of blood, and a difficult respiration, and after suffering extreme anguish he expired. Upon opening the body, his lungs

(*f*) Observ. Anatom. Chirurg. Centur. Observ. 2.

lungs appeared stuffed with thick matter, and the pericardium was so far distended with grumous blood, that it filled half the space of the thorax. The exterior surface of the heart appeared all over ulcerated, as if it had been deeply eaten by worms, and it was even so much disfigured, that it was impossible either to discover its auricles, or the large blood-vessels passing out of it (g). But besides these causes, there are others which often occur, from which a preternatural dilatation of the heart more frequently arises. The action of the heart, we know, consists in receiving the blood from the veins into its cavities, and in forcibly propelling the same blood from those cavities into the arteries throughout the whole body, in such a manner that its ventricles may be entirely emptied at each systole. The force of the heart ought therefore to overcome the resistance of the arteries; but if their resistance is from any cause increased, so far as to overcome or exceed the force of the heart, this last cannot then propel its blood into them, but being accumulated in its ventricles, it will preternaturally distend or dilate them. But the heart appears to be so easily and surprizingly irritable, that even after death it will renew its contractions barely by propelling the blood into its cavities, by inflating or injecting warm water; and therefore the blood being entirely discharged from its ventricle at each systole, will stimulate it to contract more frequently, in order to be freed of its contents, which evidently appears in the last agonies of death, when the heart is no longer able to force its blood into the arteries, for its motion is then palpitating or trembling 'till it is at last still, being overcome by the insuperable obstacle or resistance. But while the heart struggles by its strong and repeated endeavours to overcome these resistances, the fibres composing the sides of its cavities will be powerfully distended by the contained blood, which, whilst contained in the ventricles, will exert the action or resistance of a solid:

(g) Acta Physico-Medica, &c. Tom. II. pag. 47.

and : hence the fibres of the heart will be continually weakened, and its cavities will be always enlarging.

It is therefore apparent, that even a slight cause will produce an aneurism or dilatation of the cavities in the heart ; whose force exceeding the resistance of the arteries, it continues of the same dimensions ; but when the resistance of these last exceeds the force of the heart, its cavities then enlarge.

Now this preternatural dilatation of the heart may happen either in the right ventricle only, from the free passage of the blood being obstructed in the pulmonary artery ; or else only in the left ventricle, from too great a resistance in the aorta ; or when the blood's course is impeded through both of them, both ventricles of the heart may be thus dilated. It is remarkable, that when the blood's course is impeded through the pulmonary artery, then only the right ventricle of the heart may be preternaturally distended without any injury to the left, but not the reverse : for when the left ventricle cannot expel its blood, neither can the pulmonary vein discharge the blood it contains from the lungs into the left ventricle, hence neither can the pulmonary artery send its blood into the vein, whence the resistance to the right ventricle will be increased, and its cavity therefore dilated. Add to this, that the right ventricle is much weaker than the left, and will therefore more easily yield to a distention, whence it will be (*cæteris paribus*) more frequently dilated into a larger capacity than the left ventricle.

We have many observations, teaching that the heart is thus frequently distended ; but it may be sufficient for us to remark only a few. A lad was troubled with an asthma from the fifth year of his age, and had tried most remedies without success, by which his life was miserably protracted to the age of fourteen, when he perished of a suffocation. Upon opening the body the heart was found adhering to the pericardium, and both its ventricles were prodigiously enlarged (*b*).

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(*b*) Medical Essays, Vol. II. pag. 323.

In another young man, who expired after violent palpitations of the heart, the left ventricle was found three times larger than the right (*i*). And in the same place we have an observation taken from Dionis, who found the right auricle so far dilated, that it was equal to the head of a new-born infant. A man thirty-four years old expired, after having suffered tedious and violent palpitations of the heart, whose ventricles were found vastly dilated, though its substance was as thick as usual, or naturally ought to be; the aorta was also ossified at its egress from the left ventricle of the heart (*k*). Another man of twenty-five years old, who was a runner, pale and short-winded, was ill of a quinsey, from which he recovered; but yet his difficulty of breathing continued, and a palpitation of the heart frequently returned, especially after hard walking, at length he died suddenly. Upon opening the body, the heart was found three times larger than usual, or naturally it ought to be; and after removing the pericardium, and discharging all its contained blood, it weighed two pounds and a half (*l*) by a pair of scales; and yet the left ventricle in this subject was twice as large as the right.

Every thing therefore which increases the resistance to the blood's motion from the heart, may occasion a preternatural enlargement of its ventricles. Such as a too great redundance of juices in those who are plethoric; a too great velocity of the blood in acute diseases, or an obstruction of its passage through the arteries, from an inflammatory disposition, or from polypous, or atrabilious matter, &c. a defect in the arteries, through which the blood's free course is impeded, as when they become too tough or callous, or degenerate into a cartilaginous, aneurismatic, or bony substance, &c. all which make the principal causes from whence the cavities of the heart are usually dilated beyond their

(*i*) Philosoph. Transact. Tom. V. pag. 229.

(*k*) Acad. des Sciences, l'an. 1735. Hist. pag. 29.

(*l*) Lancisus de subitaneis mortibus, pag. 127, 128.

their natural dimensions. But among the rarer causes of this disorder we may reckon the air, which has been sometimes found in the cavities of the heart, distending them immensely. (m) *In muliere subito mortua reperitur cor stupendæ magnitudinis, ab aëre, quo plenum erat, absque ullo fere sanguine; id quod palam factum cuspidæ cultelli: eo enim adaucto tam subito subsidebat cor, ac vesica aëre repleta, & cuspidæ cultelli attracta:* “ In a woman who died suddenly, the heart was found of a stupendous magnitude, by reason of the air with which it was full, containing scarce any blood, as appeared from the point of the knife, which being entered, the heart suddenly subsided, as if one had punctured with it a bladder full of air.” Perhaps the blood might disengage its contained air, from some disease, intense heat, violent exercise, &c. which being collected in the larger cavities receiving the blood, might thus violently distend them.

That this disorder is either present, or at least threatened, may be known from the violent palpitation of the heart, attended with the signs which denote that the free course of the blood is obstructed through the lungs: especially if the pulse be full and hard with an intolerable anguish, increasing upon exercise; for then one may reasonably conclude, that some obstacle is about the aorta.

In this disorder the circulation is so much perverted, and such extraordinary symptoms produced, that they seem unaccountable, or beyond the laws of nature in the animal œconomy: for the pulse varies and appears in all shapes, sometimes weak, sometimes strong, and the respiration difficult; sometimes the patient is taken with violent convulsive motions, while the heart stops, and a little after will be contracted with a violent cramp: so much is the regular motion of the blood perverted in one moment, that its course through the arteries of the encephalon is first stopped, then accelerated, and from thence the secre-

tion and motion of the nerves juice is wonderfully disturbed. All the senses both external and internal are abolished or perverted, the patient being afflicted with the severest anguish, and frequently struggles betwixt life and death, until the latter puts a period to the direful malady.

From hence it also appears, why such a train of frightful symptoms often remains after an obstinate asthma, or after violent inflammations of the breast, &c.

When this disorder is once produced, there is but little hopes of removing it; for the heart being once weakened, the disorder constantly increases, and the obstacles to a cure are more difficult to remove; and especially if the patient be of an active life, all the symptoms augment daily, notwithstanding all the assistance of medicine.

All that physick can do in this case, is to lessen the increase of the malady, and to render the miserable life of a patient a little more tolerable. This may be done by interdicting the patient from all motion whatever that can be possibly avoided, that the action of the heart may be no stronger than is absolutely necessary to the continuance of life: in short, a perfect rest both of body and mind is here required. The patient ought to drink plentifully of thin liquors, of which whey, milk and water with honey, spaw-waters with milk, &c. are the chief. The food should be sparing, mild or little tasted, thin, and taken in small quantities, that the chyle may mix slowly with the blood, and every thing stimulating must be carefully avoided. The medicines exhibited ought to be such as dilute the blood, open the vessels, and lubricate the passages; to facilitate the course of the diluted juices through the lubricated and pervious vessels.

S E C T. CLXXVII.

OR if an artery be wounded by any of the preceding causes, and is not firmly enough secured, either while or after it is healed, the same tumour (176) then follows.

When the temporal artery is opened by Surgeons, either in acute or obstinate, or chronical diseases of the head, and especially in head-achs, they always use the strictest precaution to secure the wound of the artery, by applying a plate of metal, or some other firm compress, to prevent the incipient rudiments of the cicatrix from dilating by the impetus of the blood, at every systole of the heart, which would otherwise force or extend it beyond the natural dimensions of the artery, and form an aneurism: and if this compression of any wounded artery be neglected, there almost constantly follows such a dilatation of it. This has been often unfortunately observed true in the flexure of the arm, when the adjacent artery has been wounded there, together with the vein, and not afterwards secured by a fit compressure, which is much more difficult to make in this part than in the temple, where the artery may be so closely compressed against the hard bones of the cranium, as to prevent the least danger of a future aneurism. On this account it is, that arteriotomy may be pretty safely performed in the temples, an operation which Physicians are in general too much afraid of, since it may be securely performed by skilful Surgeons, and may relieve many disorders which have been in vain treated by other means, as SEVERINUS, (a) demonstrates by many observations. See also what has been said of an aneurism from this cause, in the comment of §. 160.

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S E C T.

(a) Marci Aurelii Severini de efficaci Medic. Lib. I. part. 2. pag. 40, &c.

S E C T. CLXXVIII.

WHEN all the coats of an artery are ruptured from the same causes (176), so as to extravasate their contained juices into the adjacent parts, by not meeting with any exit, but distending the parts, a tumour is thereby formed of extravasated blood, which continually increase without measure, appearing soft, livid, with scarce any pulsation, and hardly diminishing by compressure, but by putrifying in a little time it occasions a gangrene of the adjacent parts. And this is termed a spurious aneurism, whose causes (160), signs, and consequences, are apparent from this description.

If an artery be injured or wounded, so that its contained blood escapes out of its cavity, and the extravasated blood be retained either by the skin remaining entire, or being prevented from escaping through the skin, if wounded, by the fat or congealed blood; then that which is confined makes its way into the cellular membrane, which it often fills or distends into a considerable tumour: for the blood being continually forced out of the ruptured artery, will increase the distended mass, 'till the skin will admit of no farther extension, or 'till the resistance of the adjacent parts hinders the cellular membrane from receiving any more blood; or, lastly, 'till a thrombus or lump of congealed blood occludes the orifices of the wounded artery. Very large tumours of this kind are often formed under the pellucid skin from violent contusions, appearing livid and often quite black, from the extravasated or congealed blood. And the vessels being eroded in scorbutical habits, often produces the like appearances, only as the arteries ruptured in this

last case are very small; therefore the blood is not forcibly expelled, as to distend the parts into a tumour, but spreads itself under the skin in black or livid spots. It may be sufficient to shew, how large a tumour may be formed by a rupture of an artery, barely from one instance. A lad of seventeen years old was wounded with a bullet in the thigh, at about the distance of eight fingers breadth from the groin, after which followed a profuse hæmorrhage, that was restrained by the help of a Surgeon; but on the day following a large tumour appeared with so strong a pulsation, that it elevated both the hands forcibly compressing it; in the mean time blood often started out from the wound at intervals, in the quantity of two or three ounces, and then it would stop again of itself. Thus the wound went on to the fortieth day after its infliction, at which time it was agreed in consultation to lay open the part, and secure the wounded artery by ligature, to restrain the hæmorrhage, though the patient was at the same time almost spent with a fever, and great weakness. After making an incision, a large quantity of grumous blood immediately offered itself to view, which M. SEVERINUS (*a*) extracted with his own hand, to the quantity of six pounds in weight; but the wounded artery being thus freed from the compressing weight of the blood, began to force a fresh hæmorrhage, 'till an expert Surgeon made a ligature above and below, upon the half-wounded artery, by which means the patient was perfectly cured within the space of six weeks time, even without any diminution of the strength or bulk of the limb wounded. From this case it is apparent, what a vast quantity of blood may be retained in the panniculus adiposus, and what length of time it may lie extravasated without corrupting, provided it does not communicate with the external air.

Because a tumour, like that now mentioned, has the same appearance in common with an aneurism, therefore

(*a*) Ibid. pag. 51.

fore it is called by that name, but with the addition of spurious to distinguish it from the true aneurism. For in this last, or the true species, the coats of the artery, though much weakened, are always entire, so as to prevent the blood from escaping into the adjacent parts, as it does when the coats are ruptured in the spurious aneurism. The Ancients called it by a name much more express (*ἰκχίμωσις*), which, as Galen (*b*) says, generally arises with a contusion or rupture of the vessels; though he also observes that it may sometimes arise (*per anastomosis, diapædesin, & anabrosin*), from too great an opening, an erosion, or a distention. And small tumours of this kind from extravasated blood, under the entire skin, are by Surgeons called to this day by the name of ecchymosis; but if the tumour be very considerable, or formed by the rupture of an artery, especially if it has any pulsation, we then denominate it a spurious aneurism.

There is no mention made of an aneurism in Hippocrates, as far as I can find; and the definition which Galen (*c*) gives of an aneurism agrees more with the spurious than the true one. For he says, *Arteriæ autem apertæ affectus aneurysma vocatur: fit autem, quum illa vulnerata ad cicatricem quidem pervenit circumposita cutis, manet tamen vulnus arteriæ, nec coëuntis, nec cicatrice obductæ, nec carne obturatæ*: “The disorder in which there is an apertion of an artery is called an aneurism, which arises when that vessel being wounded, the ambient skin is indeed cicatrised, but the wound of the artery remains open, without uniting, or being closed, either with a cicatrix or flesh.” But then the signs by which he distinguishes this from all other preternatural tumours, rather agree with the true aneurism; for he adds, *Dignoscuntur hujusmodi effectus pulsibus, quos edunt arteriæ; sed & quum comprimuntur, tumor omnis delitescit substantia*.

(*b*) Method. Med. Lib. IV. cap. 1. Charter. Tom. X. pag. 79

(*c*) De tumoribus præter naturam, cap. 11. Charter. Tom. VII pag. 319.

stantia, quæ ipsum efficit, in arterias recurrente ;
am alibi ostendimus, tenuem esse & flavum quemdam
anguinem tenui & copioso spiritui permixtum : hic vero
anguis longe calidior est illo, qui in venis continetur, &
vulnerato aneurismate erumpit, ut vix sisti possit : “ These
 tumours are known by their pulsation which they
 receive from the arteries ; and when they are com-
 pressed all the swelling disappears, from their di-
 stending matter returning into the arteries ; which
 matter we have in another place shewn to be a
 sort of thin and yellowish blood, mixt with a great
 deal of subtil spirit : but then this blood is much
 warmer than that in the veins, and when the aneu-
 rism is wounded, it starts out so that it can scarce
 be stopped.”

The cause therefore of a spurious aneurism may be
 every thing which wounds or opens the sides of the ar-
 tery, while the skin at the same time remains entire,
 or at least so closed, that the blood cannot have a free
 passage through it from the wound, whence it is ac-
 cumulated, and distends the cellular membrane.

But it is of the utmost consequence to distinguish
 the true from the spurious aneurism ; and therefore the
 signs of this last ought to be particularly known. A
 spurious aneurism is discovered partly from the pre-
 ceding causes, especially violent contusions, and from
 the sudden formation or increase of the tumour which
 happens much slower in the true aneurism. The tu-
 mour is also here more irregular, or not so distinctly
 limited or circumscribed, because the blood spreads
 always in the cellular membrane ; whereas in the true
 aneurism the tumour is limited by the dilated coats of
 the artery. Add to this, that in the true aneurism
 there is always a manifest pulsation corresponding to
 that of the artery, especially towards its first forma-
 tion, before it is arrived to any formidable bulk ; but
 in the spurious aneurism, the pulsation is less sensible,
 though this circumstance is not altogether infallible,
 as may appear from the case lately quoted from SEVE-

RINUS. In a true aneurism, that is not very large, the tumour wholly disappears by compressure from the distending blood returning into the artery; but this does not happen in the spurious aneurism, for the being pressed in any part, indeed yields, but then the tumour is increased in the adjacent parts. Lastly, the colour of the skin is seldom or never altered in the true aneurism; at least in the beginning of it; but in the spurious aneurism, the blood being extravasated under the skin, makes it appear of a black, livid, or other preternatural colour.

The principal effects or consequences of a spurious aneurism, are, that the extravasated blood will impede or incumber the action of the adjacent parts, and by stagnating may corrupt or become acid, so as to produce an inflammation, gangrene, or frightful suppuration. But if the air be prevented from having access to the extravasated blood, it may then, indeed continue a long time unaltered, especially if treated with such applications as strongly resist putrefaction. But concerning the cure of this and other such like disorders, we shall treat when we come to §. 334.

S E C T. CLXXIX.

THE other effects following from a division of one of the larger arteries (161), are easily understood from the physiology of that vessel, so may likewise be understood the phenomena (162) of a division of one of the large nerves.

All these have been explained in the commentaries belonging to §. 161, 162.

S E C T. CLXXX.

BUT to have a clear idea of the causes producing those wonderful effects which appear

follow from the nerves being either punctured, or but partially divided, agreeable to what has been said before (in §. 163, 164, 165) we are to make the following considerations from anatomy and physiology.

Nothing is more extraordinary in the whole practice of physick, than that a slight puncture of a nerve in a healthy person, should disturb all the functions of the whole body to such a degree, that no part retains its natural and healthy state. For not only severe inflammation and acute fever, but also a delirium, convulsions, gangrene, with death itself, have sometimes followed such a slight wound or puncture: but the whole history of diseases teaches us, that all the actions of the body may be sometimes wonderfully perverted, by making the slightest change or impression upon the nerves.

For example, what commotions are produced by tickling the soles of a person's feet; almost all the muscles and tendons of the body are then immediately put in motion; the person soon loses all his strength, and a laughter is extorted against the will, nay, even convulsions, and death itself, have been sometimes known to follow from so slight a cause; and what is more, the bare threatening thus to tickle a person who has experienced it before, did once produce the same effects. The bare agitation of a feather in the nose, or fauces, the creeping of worms in the stomach, or the phlegm which flows into those parts, sometimes throws the body into such surprizing commotions and disorders, merely from the slight mechanical change they make in the nerves, dispersed through those parts.

Although we are not able to explain all the wonderful effects which are observed to follow from the nerves, notwithstanding we are at this day so well acquainted

quainted with the structure of the body, yet our acquaintance with that anatomical structure will afford us much light in those effects which follow from wounds of the nerves; and therefore we are to look into the following considerations taken from anatomy and physiology.

S E C T. CLXXXI.

EVERY visible nerve is a bundle of smaller nerves connected together by their membranes, interwove with small arteries, veins, and lymphatics, the whole being finally included in one common integument.

Through all these small vessels in the composition of a nerve, juices continually flow each within its proper canals, from the heart, brain, cerebellum, and spinal medulla. And in all the forementioned parts, there is always a strong contractile power exerted.

Every visible nerve, &c.] For we are in this place considering only those nerves which are visible to the eye, and which, as we said before in the commentary to §. 162, anatomists have observed to be divisible into other lesser nerves, each of which is like the large nerve or fasciculus of small nerves. (a) Lewenhoeck found a little nerve, no thicker than a hog's bristle to consist at least of thirty lesser ones, each of which was invested with its proper membrane; and the same structure he also observed in much smaller nerves. He likewise observed small blood-vessels running betwixt the nervous fibrils; and anatomical injections, especially those made upon young animals, teach us, that an infinite number of small vessels are distributed through the whole substance of the nerve. All the visible nerves are therefore composed of but a small part of

(a) Tom. III. Epist. 36. pag. 350. & alibi pluribus locis,

at substance which is properly the nerve, or a continuation of the brain and cerebellum, with the medulla oblongata, from whence all the nerves arise. The teguments investing the nervous filaments, with the connecting membranes and vessels of all kinds distributed through them, compose the greatest part of all the visible nerves, which mechanism was necessary to defend those very tender and invisible vascules, that they might be safely conducted each to its respective part of the body, for performing the proper action of the nerve, after the deposition of their thicker integuments. Thus the optick nerve appears to receive membranous integuments from both the meninges of the brain, which render it very tough and firm in its progress; but after having deposited those integuments at the fundus of the eye, the proper substance of the nerve is then expanded in the retina, whose substance is so soft, that if it was not every way sustained by an equal pressure from the humours, it would collapse like a kind of mucus. But yet we are plainly taught by anatomical injections, that a great number of small arteries are dispersed through the middle of the retina. Through all these small vessels, &c.] All these small vessels, in the composition of the visible nerves, receive their blood and juices by a proportionable impulse from the heart and arteries, of which we have not the least reason to doubt in those small vessels which compose the tunics investing the nervous fibrils, since anatomical injections forced into the arteries have penetrated into them. But that the proper substance of the nerve itself is pervious, and continually carries a subtle liquor moving through it, can by no means be demonstrated to our senses. But if it be considered, that the medulla of the brain and cerebellum arises from the vascular cortex, and is directly continued into the nervous fibrils, together with the vast quantity of pure arterial blood, which is sent to the brain; also that if the medulla of the brain or cerebellum be compressed, all the actions of the nerve thence arising

are destroyed; and lastly, that if any of the nerves be tied in their progress, all its action is destroyed below the ligature, without at all affecting it above the ligature, it will from thence appear sufficiently evident that the nervous fibrils receive a very subtile fluid, separated in the brain and cerebellum, and continually distribute the same during life, by distinct canals, to every part of the body, for performing the very distinct action of motion and sensation.

Every visible nerve therefore which is wounded, suffers not only as it is a nerve, but also as it is a composition of membranes and vessels of all orders, whose continuity and action are also injured by the wound.

But as all the nervous fibrils arise very distinct from the medulla of the encephalon, and are in their progress invested with their proper integuments from the pia mater, separating them from each other; and as the whole nerve, or fasciculus of fibrils are again involved in a very thick and common integument, it thence evident, why all the visible nerves appear hard and tough, when at the same time the substance which is properly the nerve, is a production of the soft medulla of the encephalon. The contractile power therefore of every visible nerve, by which its extremities recede after division, results entirely from the membranes investing the nervous fibrils, and from the small vessels which run betwixt them.

S E C T. CLXXXII.

Therefore the parts of a nerve which is totally divided, recede or fly back from the lips of the wound towards the solid parts to which they are connected, and by which they are covered and compressed, so as to close the orifices both of them and their small vessels, and therefore no other damage follows but what was before-mentioned 162.

If one of the visible nerves before described be totally divided, the membranes investing each fibril, and the common integument investing the whole nerve composed of them, will by their elasticity and connection to the adjacent parts, contract the ends of the nerve from each other. But as very considerable series being divided, do by their contraction with pressure of the adjacent parts, in which they are concealed, so close their orifices, as to prevent any blood from escaping; so it is very evident, that the small tubuli of the nerve, together with the vessels dispersed through its membranes, will by the same means be compressed, so as to prevent them any longer from transmitting their contained juices. All their functions therefore which depended on the continuity of the nerve and its vessels, will be destroyed; and those accidents will follow, which are enumerated in §. 162.

S E C T. CLXXXIII.

BUT if a large nerve be so cut or punctured, that only some of the smaller nerves, in its composition, are divided, these smaller fibrils and vessels, which connected the lesser nerves together, (181) will be stretched or drawn by the recession of the divided parts, so as thence to occasion a constant and slow laceration; and therefore a violent acute and continual pain will follow. That part of the nerve which continues undivided, will now sustain all the force which the whole nerve did before; thence a greater distraction and laceration of what remains, which will therefore be compressed so as to deny a passage to the reflux juices, and excite the most acute pain. But while the divided parts thus affect those which remain entire, the interspersed vessels will be thence also compressed;

fed; from all which the blood, lymph, and spirits will be obstructed, pressed and accumulated, whence an inflammation in the blood lymphatic and spirituous vessels in the adjacent parts.

From hence again the adjacent nerves, tendons, and the integuments of both, with the muscles and vessels, will be stretched, contracted, and convulsed; whence again the meninges of the brain, cerebellum and medulla spinalis, will be contracted and vellicated, and the action of the brain itself disturbed.

From all which will naturally and necessarily follow the whole series of phenomena mentioned 163, 164, 165.

If now a visible nerve, consisting of many small nerves, connected to each other, and invested with common covering, be thus injured, some of its fibrils being divided, and others remaining entire, all functions which resulted from the continuity of divided fibrils will be destroyed. But it is apparent from what has been said at §. 158. numb. 1. that divided fibrils cannot recede from each other, without distracting and lacerating the entire nervous fibril, whence will arise an acute and continual pain. But entire fibrils will now sustain all the force which before allotted to the whole nerve: and from the various actions and extensions of the muscles, inflexions of the joints, pulsations of the arteries, &c. the distraction will be again increased, and consequently pain will from hence become more intense. For if a nerve be supposed to consist of a hundred fibrils, and that 10 of them are divided by a wound, those which remain entire will then be twice as much extended by the continuance of the same force, since half of the resistance which resisted the distracting power is now

oved. But it has been shown in §. 112. numb. 3. that every cause which distracts and elongates a vessel, diminishes its capacity, from whence may arise an obstruction, which will again prove another source to invite disorders. Thus we begin to perceive what maladies follow from a nerve that is partially divided, since the retrocession of the divided parts will contract the orifices of the wounded vessels, and prevent the passages of their contained juices, while the fibrils which remain entire, being sufficient to sustain the standing force, will be elongated, so as to diminish the diameters of its vessels, from whence again the circulation of the juices through those vessels will be impeded; and the vital juices being still urged on the obstructed parts, will cause an inflammation not only in the larger blood-vessels, but also in the serial series of the lesser decreasing vessels, down to the minutest, or even the tubuli of the nerve itself. But what excruciating pains may thence arise, we are taught from the fixed or wandering gout and rheumatism, in which diseases the minute and inflamed vessels are most severely tortured. But when once an inflammation is produced, it may terminate variously, according as it is seated either in the larger or smaller vessels: thus a phlegmon ends in a soft suppuration, but an erysipelas being seated in the smaller and pellucid vessels, ulcerates and discharges a thin ichor, or sharp serum; a rheumatism again rather occludes and leaves a stiffness in the small vessels, without ever suppurating; and lastly, the gout destroys the most subtile vessel of the nerve, and converts the most compact solids into calx, &c. from either of which may again spring innumerable other disorders.

From hence again the adjacent nerves, &c.] Such commerce or consent do we observe in the fabric of the human body, that when one small nerve is injured, those adjacent, and sometimes even the remote, are so affected at the same time. When the vitreous humour or enamel of a tooth is either broke off or destroyed,

stroyed, so as to expose the tender fibrils of the nerve within the bony substance of the tooth to the air, so slight a cause will not only excite a most severe pain in that tooth, but also affect that whole side of the head on which the tooth is seated, and often distend or swell the soft parts adjacent to an uncommon degree; but when the aching nerve is destroyed either by the application of alcohol, or by an evulsion of the tooth, the whole malady ceases. When a needle is unfortunately thrust by accident into the last joint of the forefinger, so as to hurt the tendon, a severe pain and inflammation soon follows through the whole hand, wrist and arm, up to the shoulder, and extending into all the adjacent parts, tends to a speedy gangrene; insomuch that so slight a wound has brought on a most acute fever, delirium, convulsions, and even death itself within four days time. Instances of this nature we have several in Hildanus, and the other writers of observations, from which it is evident, that a slight puncture of a nerve or tendon may soon affect all the adjacent parts, and pervert the several functions, so as to destroy the patient. But whether the disorder arising in one nerve propagates itself to the rest, and to the brain, by the continuity of the investing membranes of the nerves, which are extended from the meninges of the brain; or whether the irritation spreads by that soft substance which is properly the nerve, and continued from the medulla of the encephalon, I shall not here dispute: it is sufficient that such accidents follow injuries of the nerves, and possibly by both those ways. When the membrane investing the cavity of the pelvis in the kidneys and ureters, is irritated by a rough stone lodged in those passages, the membrane is continued even into the bladder and urethra, a pain is thence very often perceived, even at the extremity of this last, and a most severe stranguaria is produced. When the tendinous fascia or aponeurosis which invest all the muscles of the humerus and cubitus, is wounded by the lancet in phlebotomy, ho

speedily

speedily does a severe pain, inflammation, and other bad symptoms, spread through the entire limb, and affect the whole body.

The whole series of phænomena, &c.] Whoever compares what has been delivered at §. 163, 164, 165, with what has been said in the last and two preceding paragraphs, will readily perceive the reason why so many violent symptoms follow injuries of the nerves.

S E C T. CLXXXIV.

AND from thence may likewise be understood what and why a puncture, laceration, or wound of a nerve, proves so dangerous or fatal. And also why tendons, membranes, and vessels, thus injured, are followed with many of the same symptoms.

The more tense the nerve, and the fewer the fibres of which remain entire, the greater is the distraction of it, and the more severe will be the pain and other consequent symptoms. But such severe symptoms do not follow from a wounded nerve, that is lax or totally divided. Nor is it at all strange, that the like symptoms should follow wounds of the membranes and tendons, since the first have many nerves distributed through their substance, and the last are composed by a continuation of the fibres in the muscles, which are productions of the nerves, as we observed in the commentary to §. 164. And the like may also obtain in the vessels, composed of convoluted membranes, through which many nerves are likewise dispersed for their sensation, motion, and nutrition.

We have already considered the definition, causes, and effects of wounds, and then given a faithful account of all the accidents or appearances attending a simple wound, from its first infliction 'till the cure is compleated. We next considered what might happen

to a wound from injuries of the arteries, nerves, tendons, membranes, &c. and afterwards we described the signs whereby to discover a wound, and to know what parts it has penetrated; from all which was deduced the presages to be made as to the life or death of the patient from the known wound, with the easiness or difficulty, length or shortness of the cure, and the defects or injuries that will remain from the wound when the cure is compleated. In the next place, we determined from certain observations, and the known structure of the parts, what wounds are to be deemed mortal, and under what restrictions; whether absolutely so, from a destruction of the parts immediately necessary to life, so as to be irremediable by all the art of the present day; or whether mortal in their own nature, but curable by a proper treatment. And lastly we made an enquiry as to the patient's death, whether it resulted from the wound only, or from other concurring causes at the same time, distinct from the wound itself, from all which one might be able to make a report to the Judges concerning the nature and effects of a wound. And we have now been giving the reasons from anatomy and physiology of the wonderful symptoms which follow from puncture and partial wounds of the nerves, it therefore only remains for us to give the general treatment or method of curing wounds.

S E C T. CLXXXV.

IN order to the cure of a wound, it is necessary :

1. To free it from every thing foreign, whether from the solids or fluids corrupted, or from the wounding instrument, &c. which remaining in the wound might impede its healing.

2. To supply the loss of substance by a new growth of the parts.
3. To close the parts divided, and retain them together in contact.
4. To induce a cicatrix, nearly resembling the true skin.

A cure, as we observed in the comment to §. 4. is the restoration of a vitiated part to its former action and integrity, by removing the disease. But a wound is a recent and bloody solution of the continuity in some soft part of the body, by a hard or sharp instrument; and therefore the cure of a wound is the restitution of the natural cohesion or union of the parts, first destroyed by the wounding instrument. Now whether the wound be only a simple division of the parts, or whether it be also attended with a loss of substance, from part being removed by the wounding cause: in both cases the remaining life in the patient unites the part divided, and restores the loss of substance by an inimitable artifice, which it is the business of the Physician and Surgeon to promote, by removing all obstacles, and by supplying every thing that may afford any assistance from art. Let those who think themselves wise enough to do more than this, endeavour to heal a slight wound in a dead body, by the application of their most renowned balsams; and let them also forward it by the warmth of a healthy person, the event will then teach, that the nature itself of the created body, while living, is alone sufficient for the cure, and that without this nothing can be done by art. In the following numbers are pointed out the things necessary to be done in the cure of all wounds.

1. Every foreign body of a different nature from the parts wounded, can never unite with them, but will always prevent their consolidation so long as it there remains. If the external skin be divided with a lancet, and a small spherule of the purest gold be thrust

thrust into a wound, the lips will never unite, but always remain an ulcer continually discharging matter; but if that foreign body be removed, the wound will then heal in a few days, if its lips are not become callous, by the contact and attrition of the hard sphere. It is the same, whether the foreign substance be part of the wounding instrument, or some other matter forced into the wound with it; or whether it be any of the solid or fluid parts of the body itself, whose nature is so corrupted or changed, as to be unable to unite with the living parts. When musket-balls pierce the soldiers' cloaths in battle, they very often carry some fragments with them into the wound, by which means such wounds are sometimes prevented from healing for many months, or even years. A certain nobleman was wounded with a musket-ball passing through his right thigh, by which the os femoris was broken: he indeed recovered so well from his wound, as to be able to sit; but then a fistulous ulcer remained for a matter of twenty years from the bony fragments, which would sometimes discharge themselves. After the patient had borne his malady for so long an interval, his pains increasing, and almost continually returning, he then suffered the orifice of his fistulous ulcer to be dilated by incision, agreeable to the advice of some eminent Physicians and Surgeons, by which means a bony splinter was extracted three inches long, after which, three other splinters were extracted, and at length some of the patient's cloaths were found in the bottom of the ulcer, which had entered the wound with the bullet. Lastly, in a few days more came out three fragments of rusty iron, which appeared to be part of a key that the patient carried in his pocket the day he was wounded. (a) For so long a space of time did these foreign bodies lie concealed in the wound, preventing its consolidation: from whence it is evident, such substances ought always to be removed, if possible.

2. If

(a) Académ. des Science, l'an. 1731. Mémoires, pag. 141, &c.

2, If a wound be inflicted with a considerable loss of substance, it is plain the lips of it cannot unite before that loss is repaired by incarnation or a reproduction of new flesh: for they would be too remote from each other, and if they were forced together by future or sticking plasters, so as to render the lips of the wound contiguous, even then there would remain a cavity under the united integuments, in which the extravasated juices would be collected, and a sinous ulcer formed.

2. It has been remarked before in §. 158. numb. 1. when we considered the common appearances of a wound, that the parts of the body wounded do gradually recede more and more from the contact of each other; but in order to cure the wound, it is required for the divided parts to be brought to meet again; in which respect art assists nature, by approximating the parts wounded, and securing them in contact.

4. Which is however frequently impracticable, when a great suppuration has consumed much of the panniculus adiposus, or when a great part of the skin has been removed from the wound; for in that case the cicatrix will always be more compact, smooth, and resplendent than the adjacent skin.

These are the general indications in the cure of all wounds, for the accomplishing of which, we shall give the directions following.

S E C T. CLXXXVI.

THE fragments of metals, stones, wood, or glass; bullets, concremented blood, dead flesh, or membranes, splinters of bones, &c. are to be first removed, when practicable, or if they are present.

These cases frequently happen in some of the modern combats, where they charge their cannon against
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the enemy with stones, old iron, glass bottles, &c. which make wounds extremely difficult to cure. When the wound begins to swell and inflame, all these foreign bodies do then bruise and lacerate the parts they touch, render them callous, and increase the inflammation, 'till the wound at last degenerates into a fistulous ulcer, incurable by all means, unless those bodies are discharged either by art, or by a natural suppuration of the contiguous parts. The same is also true of grumous blood, or pieces of flesh remaining in the wound, after a total division from the living parts. But if a fragment still adheres to the live bone, there is some hopes it may unite again. But it must always be observed, that if the extraction of the foreign bodies is not practicable, without danger of exciting very bad consequences, they ought then rather to be left to nature to discharge, But how to determine whether they ought to be extracted, or left in the wound, may be learned from what follows.

S E C T. CLXXXVII.

A Judgment may be formed, whether the foreign bodies ought to be extracted or not, from considering the nature of the wound, and the parts injured, together with the nature of the impacted matter, the strength of the patient, and the symptoms that are like to follow.

The utmost caution is required in dangerous wounds, to determine whether the foreign bodies ought to be extracted, or left in the parts. If from duly considering all the circumstances, it shall appear, that the patient may live longer or easier by clearing the wound, then it ought, doubtless, to be performed: but if from anatomical knowledge of the parts, and their functions injured, the nature of the wound appears to be such, that a removal of the bodies will threaten cer-
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tain or speedy death, they ought then deservedly to be relinquished; since desperate cases are best let alone, lest any blame of the patient's death should be imputed to the Physician or Surgeon. If the wounded parts will not admit of the instruments necessary for the extraction without danger, they ought then also to be rather left to nature; as when, for example, the foreign bodies are lodged in parts near large nerves or tendons, or in the substance of the brain, &c. in which they cannot be moved without great danger. But again, some bodies are more safely left in wounds than others, according to the different form and the matter of which they consist. Thus we learn from many observations, that leaden bullets have lodged quietly in the parts of a wound for many years, and have at last surprizingly made their own way out: but were they made of iron or copper, which so easily rust, they would much more irritate the parts in their contact. A regard must be also had to the strength of the wounded patient; for if the pulse be low, the extremities cold, and a cadaverous paleness appears in the countenance, the vital strength is then so weakened, that a prudent Surgeon will refrain from searching the wound with troublesome instruments. And we are taught by surprizing observations, that foreign bodies being left in a wound have afterwards come away of themselves, when it would have been highly dangerous to extract them. A young man of twenty-six years old had the right parietal bone perforated by an arrow armed with an iron head; while the wounded patient endeavoured to extract the arrow, the wooden part of it broke near the iron tip, which continued in the wound. He continued pretty well 'till the seventh day after the accident, when an incision being made in the scalp, the parietal bone appeared to be perforated with a round hole, through which might be perceived the point of the arrow. A large portion of the skull was cut out by twice applying the trepan, and the dura

dura mater was opened the whole compass of the aperture, but yet the head of the arrow could not be extracted. There was a palsy happened on the side opposite to the wound, a large suppuration followed, and fungous excrescences of the brain were frequently formed: at the end of three months the Surgeon felt the iron head of the arrow with his probe in the substance of the brain, and endeavoured to extract it, but was hindered in his proceeding by the patient's falling presently into convulsions. About the end of the fourth month the point offered itself spontaneously at the mouth of the wound, and was then easily caught and extracted by a pair of piers without any damage to the patient, who was in twenty days afterwards cured of so dangerous a wound, which was then cicatrised (a). There are many more observations to be met with, teaching that in many wounds we had better not extract the foreign bodies, which will be afterwards discharged more easily by the assistance of nature only.

S E C T. CLXXXVIII.

ALSO from the same considerations 187, we may determine what instruments and methods are to be used for extracting foreign bodies 186.

Let the first enquiry be whether the relicks of the wounding instrument may not be extracted without lacerating the contiguous parts, or whether it will not be better to enlarge the wound, or make a new one in the opposite part, to facilitate the exit: for example, bearded darts, &c. cannot be drawn back through the wound without violent laceration, and therefore it may be adviseable in that case to dilate the wound or rather to make a new one by thrusting

(a) Journal des Sçavans, l'an. 1735. Avril, pag. 490, &c.

ing the dart forwards through the opposite part. We have various tenacula of different figures and sizes, described by modern writers in surgery of extracting foreign bodies left in wounds; but great caution is required in using them, not to make the extraction forcibly and altogether at once; but to humour the body, and observe where it hesitates, that it may be extracted without any great laceration, or else be left in the wound. Surgeons were not provided with so convenient instruments for the extraction of bullets soon after gunpowder was invented, as they are at present; for new machines have been lately contrived for that purpose, and particularly one which consists of a spiral screw, or terebra, concealed in a hollow cannula or pipe, that it may be safely conveyed to the bottom of the wound 'till it meets with the bullet, and then by gently turning the screw, it pierces the soft lead of the bullet 'till it has got such firm hold, that the ball readily follows the extraction of the instrument; which may be seen figured in Heister's Surgery, *Plate III. fig. 7.*

S E C T. CLXXXIX.

THE wound being thus cleansed (186, 187, 188), if there be any loss of substance in its parts, that must be repaired or restored by the growth of a new similar substance in its place. And this is procured, 1. by keeping all the arterious, lymphatic, and nervous vessels disposed so as to receive and transmit their sound juices; and 2. by procuring those healthy juices to flow into those vessels with their natural or due force and quantity.

After all foreign bodies have been removed from the wound, the next enquiry must be, whether the wounding instrument has only made a bare solution
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of the continuity, or whether it has removed or taken away some part of the bodies wounded. In the first case the cure requires no more than a bare union of the parts; but in the last case it requires a regeneration of the lost substance also. It has been always the general and received opinion, that parts of the body which have been quite cut off will not adhere and grow together again, even though they be retained on the part wounded; but there are some observations teaching us, that we ought not always to despair in this respect. A soldier had almost the tip of his nose bit off by another man, who spitting it on the ground afterwards trampled upon it; the wounded soldier took up the end of his nose and flung it into a Surgeon's shop adjacent, and in the mean time pursued to take revenge of his enemy. After his return, the tip of the nose being first washed in warm wine, was then applied and retained upon the other parts wounded by a sticking plaster, and on the day following there appeared some rudiments of a reunion, insomuch that on the fourth day it was perfectly united (a). A like instance we have of the tip of the fore-finger of the right hand being cut off by the shutting of a door, so that the flesh and nail were quite separated from the bone of the last internode, like the end of the finger of a glove; but the Surgeon so reduced the parts, and retained them, that they perfectly united in the space of three days (b).

Such observations prove the possibility of the method by which TALIA-COTIUS, professor at Bologna, restored lost parts, as noses, ears, lips, &c. by cutting out a piece of the arm, and adapting to the stump of the lost part, &c. as he describes at large in his treatise, entituled, *Chirurgia curtorum per insitionem*. Parrey (c) tells us of a man, who for a long time wore a silver nose, but being weary of the deformity, he had a real nose procured by this method in Italy, to the great

(a) Garengnot, Operat, de Chirurgic, Tom. III. pag. 55.

(b) Ibid. pag. 57.

(c) Lib. XXIII. cap. 2, pag. 574.

great surprize of all who had before known him. And Hildanus relates (*d*), that one GRIFFON, an ingenious Surgeon, did by the like method which he learned from TALIACOTIUS, restore the nose of a virgin that had been cut off, and that so exactly, that it was scarce distinguishable from a natural nose, as Hildanus had frequently seen to his great surprize.

But these instances ought at most to be but little trusted to, since if there be any loss of substance in a wound, the adjacent vessels will elongate and supply the deficiency by nature in a wonderful manner. In order to effect this two things are necessary.

1. By the constant and inevitable actions of life and health some parts of the body are continually wasted, which are again restored by aliments converted into our nature by the actions of the proper vessels and viscera. There is therefore such a power in a healthy body, as is able to make from our aliments a substance in the like quantity and quality with what is daily consumed, to nourish or sustain the parts in their proper state; the whole business of which is performed by the vital motion of the healthy juices through their adequate and sound vessels: whence it follows, that such a state is required in the vessels as will enable them to receive, carry, and return such healthy juices as are naturally destined to flow through each; so that if the vessels are too much compressed, dried, or contracted by desiccatives, the surface of the wound then becomes dry and inflamed, from the vessels being incapable of transmitting their juices, which in a healthy state flowed through them. But on the contrary, if the wound is treated too much with emollients, the relaxed vessels will give way to the impelled juices, and be thereby so much dilated as to admit particles too gross for their passage; and vessels thus preternaturally distended beyond their proper dimensions by the contained fluids, constitute what is called fungous or proud flesh, which always retards the healing.

(*d*) Centur. III. Observ. 31. pag. 214.

ing of a wound. A happy restitution therefore of the lost substance in a wound, with regard to the vessels, will depend on giving them a due strength or firmness, by which they may not resist the juices too much, nor too easily give way to their impulse. But as all the vessels in the surface of a wound ought to elongate in order to restore the lost substance, therefore it will be serviceable to keep them a little softer, and more flexible than is required in their natural state. Hence Hippocrates says, (e) *Siquidem ulcus occludere & implere sit opus, tumefacere juvat*. And again, (f) *Quum vero carnem generare voles, pingua & calida magis conferunt; i. e.* “ When it is necessary to fill up and “ heal an ulcer, it will be useful to make the vessels “ swell. When you would incarn, warm and oily “ medicines are most proper.” And Galen cautions us, (g) *Ubi carni producendæ studemus, maxime cavendum ab adstringente medicamento*; “ When the extension is “ to incarn, astringent applications are to be carefully “ avoided.” But while the Surgeon daily inspects the wound, he may readily perceive whether the vessels are mollified more or less than is necessary for their gradual elongation to restore the lost substance. If the surface of the wound appears dry and of a deep red colour, affording very little matter, he may then conclude the wounded vessels resist too much the impulse of the juices and deny them a passage. But if every part of the wound appears equally moist and moderately red, the fundus of it rising gradually every day, and the sides increasing all round towards the center, these shew that the vessels are lax enough to admit the impelled juices and be thereby elongated. Yet if the wound discharges a great deal of moisture, and fills up unequally round the sides, it is a sign the vessels are too lax, and therefore require to be treated with

(e) De locis in homine, cap. 13. Charter. Tom. VII. pag. 372.

(f) De affection. cap. 10. Charter. Tom. VII. pag. 631.

(g) De methodo medendi, Lib. III. cap. 4. Charter. Tom. X. pag. 65.

with contrary medicines. Galen (*b*) has wisely distinguished in this affair, in treating of the method of curing ulcers, where he says, *Carnis autem ipsius sanabis temperiem, si squalens & sicca videatur, aqua temperata tepies humectando* — *Scopus tamen hujus humectationis sit, ut, quamprimum rubescat & attollatur moles, desinas* — *Medicamentorum humectandi facultas pleior esse debeat, quam in sana carne præceptum est. Si autem humidior, quam pro naturali habitu caro fuerit, contraria facienda jubet*; “If the fleshy parts appear foul and dry, you may remove the distemperature by frequently moistening them with some cooling water; but when the tumour and redness of the parts are allayed, the moistening should be then laid aside. The moistening applications used in such a case ought to be more mollifying than those used when the fleshy parts are of a healthy disposition: but if the flesh appears moister than it ought from the natural habit, it calls for medicines of an opposite nature.”

These are the circumstances which ought to be observed in treating a wound, with regard to its vessels, in order to regenerate the lost substance: the next paragraph directs what is required in the fluids for the same end.

2. There must now be made a reparation of the lost substance in the wound; but that consists of solids and fluids, or containing vessels and contained juices, which juices ought to contain the proper matter for accretion, when conveyed to the wound, as the healthy juices do, since from them is repaired the loss of the several solid and fluid parts which are daily consumed by the actions of life and health. For the elements do not nourish, until they have been first changed from their own nature into that of animal juices by the structure and action of the proper parts: it is therefore required for this purpose, that the patient

(*b*) De Methodo Medendi, Lib. IV. cap. 2. Chart. Tom. X. p. 81.

patient have so much health remaining, as is sufficient to convert the aliments into laudable and healthy juices. Hence you may perceive the reason why it is so very difficult, or almost impossible, to incise the wounds of those, whose blood and juices are ill-conditioned, when at the same time it may be easily and speedily procured in good habits. It is also farther necessary, that those good and natural juices abound in such a quantity, as is sufficient to fill all the vessels equably: whence again you may see the reason why the cure of a wound is so difficult in those, who have lost much of their healthy juices by a profuse hæmorrhage; the difficulty again increasing in them on the account that a large quantity of those healthy juices is required in the body to mix with the crude chyle, and convert the same into our own nature, as we observed in the comment to §. 25. numb. 1. Nor is this all that is required, but the juices must also move through the vessels with a proper degree of motion and force; for when this motion is too languid, nutrition is always either absent or depraved as we see in weak habits. But when, on the contrary the juices flow through the vessels with too great velocity, instead of recruiting the vessels they abrade and destroy them, as is evident in animals inured to hard labour, and in those diseases where the blood's velocity is too great.

This is therefore all that art can effect, namely, to preserve the vessels, as much as possible, in their healthy state, and to procure a due quantity of healthy juices to flow regularly through them: all the rest must be left to nature, which is alone able to complete the cure, as we observed in §. 158. numb. 9.

S E C T. CXC.

FOR by these means (189) the wounded vessels before drawn back, closed, compressed and almost empty, will be now filled, moistened
extended

extended, or elongated, and united to some of the adjacent vessels, while they are interwoven with others, coming from the neighbouring reticular plexus's, so that by means of good juices a consolidation follows.

It has been before demonstrated in §. 159. that wounded arteries, which are pretty considerable, gradually contract and close themselves after a total division; so that from hence, if the hæmorrhage was not very profuse, it ceases of its own accord. It is therefore hence sufficiently evident, that the smaller divided vessels will be contracted and closed by the same causes, so as to prevent their juices from escaping; but then those juices being urged forward by the vis vitæ, against the orifices of the divided vessels now obstructed or closed, will excite an inflammation and slight fever, by which the juices being impelled with greater force will thrust out and elongate, or open the contracted ends of the vessels which remain pericious, while those that are dry or mortified are separated from the living parts by a gentle suppuration. But these vessels being no longer confined by the restriction of the investing skin, will be gradually extended and elongated by the impulse of the juices moving through them, which will in part escape through their extremities into the cavity of the wound; from hence the whole surface of the wound will appear moist and spread with matter, while the incarnation succeeds by a gradual elevation of the parts in the form of little rough papillæ, which are nothing more than the protuberant extremities of the small divided vessels: in the mean time the whole surface of the wound increasing, the ends of the growing vessels will apply themselves to each other, and cohere so as to restore the lost substance in the wound. If now the mucous ends of the vessels increasing are daily abraded by the Surgeon, in wiping off

off the matter, he will destroy the incarnation or restitution of the lost substance, whereby the cure will be retarded, and the surface of the wound turned into the nature of a fordid ulcer. All that art therefore can do towards the restitution of a lost substance in a wound, consists in keeping the vessels in a due state of resistance, and in regulating the impulse of the juices through them; so that their motion may be neither too languid nor too impetuous: all the rest is to be performed by the nature of the human body itself, as we said, §. 158. numb. 9.

The consolidation of the divided parts seems to be performed by an apposition of new matter, and not by the interposition of a juice like glue, serving to unite the extremities of the divided vessels; for we see, that if the naked vessels are contiguous after the cuticle and skin have been separated, they will then grow together. Thus, the margins of the eye-lids being excoriated, have grown together so firmly in one night's time, that they have been forced afterwards to have been divided by the lancet: and even sometimes the fingers have grown very firmly together, after the cuticle has been destroyed by burning with gun-powder: so great is the inclination of wounded vessels to unite with each upon contact.

S E C T. CXCI.

WHILE all these (190) are performing, the sides, and especially the bottom of the wound, send out a matter from every point with an equal force, by which the cavity of the wound is replenished both with vessels and juices resembling those which were destroyed.

If now the extremities of all the divided vessels in the bottom and sides of the wound remain equally pervious, then the impulse of the juices moving through

through them, will act upon all with an equal force, so that the vessels will be thereby elongated equally in every point of the wound, if there be no more resistance in one part than another; but if some of the vessels are more lax than the rest, they will be more distended and elongated than those adjacent, whence will be formed a fungous excrescence, which by compressing the neighbouring vessels, will impede the equable incarnation and cure of the wound. It is remarkable, that while the vessels are thus elongated and extended towards each other all round the surface of the wound, they are at the same time formed hollow or tubulated, so as to supply the place of those vessels which were consumed in the lost substance of the wound. But whether or no the vascular compages thus regenerated, is altogether the same as before the wound was inflicted, can hardly be determined absolutely; though we are taught the truth of this in a great measure by experiments, *viz.* that the large and small blood and perspiring vessels regenerated, are very much like those before destroyed in the wound. For if one roughly wipes the mucous congeries of growing vessels, the red blood follows; and if you do but slightly touch them, they discharge a thinner juice. Add to this, that if the surface of a looking-glass be applied, there will be a moisture formed upon its surface, which quickly evaporates without leaving any fordes; a manifest indication, that in the congeries there are some vessels which contain and discharge the most subtil and volatile juices: from whence we may with probability conclude, that as there are blood-vessels, and the smallest exhaling vessels, so also that there are the several intermediate series of decreasing vessels.

It must however be observed, that this restitution of a lost substance in the human body has its limits. For if a finger, or only the last joint thereof, be amputated, no one ever observed it to be regenerated again; the wounded vessels in the extremity will in-

deed coalesce and form a cicatrix, but then the part will remain deficient as long as the patient lives. Hence it seems practicable for a lost substance to be regenerated, when the divided vessels can elongate and concur together towards the center, from the whole circumference of the wound; but when it is required for the elongating vessels to form an organic part, which has been amputated, nature finding herself unequal to the task, closes the wound with a firm cicatrix. But it is deservedly the subject of admiration among the learned, that man should be deprived of a faculty which is possessed by other animals; for large craw-fish and sea-crabs have their whole legs regenerated compleatly, after they have been broken off, as we are assured by those who inhabit the sea-coast. Many Philosophers indeed ridiculed this account as fabulous, and no more than the common report of the vulgar; but the ingenious REAUMUR (*a*), to whom we owe many happy discoveries in the history of animals, has found this regeneration of the limbs to be matter of fact.

This great naturalist cut off one of the large claws of a craw-fish, which serves forcibly to catch and hold their prey; and he observed, a day or two after, that the wound was covered with a reddish membrane; in a few days more the plain surface of the said membrane appeared convex, and a little after there was formed a conical protuberance in its center, which frequently grew in the space of ten days time to the length of three lines. The red colour of the protuberant membrane was afterwards converted into a white one, and the red point in its extremity came off. Under this membrane the visible rudiments of the new-forming part lay concealed; for after four or five weeks time, this including membrane burst, and the regenerated member appeared naked, but yet soft, though in a few days after it was invested with as hard a case as that which was cut off, so that there appeared

(*a*) Academ. des Sciences, l'an. 1721, Mem. pag. 296, &c.

eared no difference between the new limb and that which was amputated, except in magnitude, and even that it seemed to acquire by degrees. In this manner all the parts were perfectly regenerated, which he cut off by repeated experiments on these animals, such as the claws, legs, horns, &c. separated at different distances from the body.

But what is more, if the part thus regenerated be cut off again, it will be afterwards reproduced in the same manner; nor has it been yet proved by experiments, whether this faculty of regenerating lost members can be this way exhausted from the animal. Thus we see in physical matters, that general conclusions deduced from a few particular observations, are often fallacious, and sometimes refuted by new and unobserved instances.

S E C T. CXCII.

FOR this purpose (189) therefore is required,
 1. A proper diet, by which the chyle and serum of the blood may be replenished, with a mild, glutinous, and nutritious matter, capable of being digested easily without putrefying, and of being perfectly assimilated. Of this nature the chief are farinaceous decoctions, either boiled only or fermented, emulsions, milk, broths, ripe fruits, boiled and mild vegetables for the most part, taken frequently and in small quantities, equally avoiding repletion, with hunger and thirst.

All that is regenerated in the lost substance of a part, must arise from the juices brought by the vessels to the wound; but these other juices which flow thro' the vessels, are either crude and composed of the aliments, not yet perfectly assimilated into our own nature, or else they are such as have been converted into animal fluids, by the actions of the vessels and vis-

cera, with their contained juices. The chyle formed from our aliments by the chylificative viscera, circulates in a crude state for some hours, with the blood in the arteries and veins, as appears from the experiments of Lower, mentioned in §. 80: hence the crude chyle will be brought with the other juices to the wounded part, and that in a greater proportion than to any of the rest, since the wounded vessels have the least resistance: from whence it has been observed in large wounds, that almost the whole matter for nutrition escaping this way, has so defrauded the parts of their daily nourishment, as to destroy the patient by a lingering consumption. Unless therefore proper care be taken that the chyle, afforded by the aliments, be mild and not acrid, by ordering a proper regimen of diet, the wound will otherwise be daily irritated by the acrid chyle, and its cure will become difficult. We here speak with regard to considerable wounds, for those which are slight require no such great caution. It is farther observable, that the open orifices of the vessels discharge much of their contained juices into the cavity of the wound, the most solid parts of which being either exhaled or absorbed, the remainder is converted into laudable matter; but if the chyle and blood brought to the wound, consists of such parts as are naturally too much inclined to putrefaction, then the extravasated juices in the cavity of the wound will not be converted into laudable matter by warmth and stagnation, but they will degenerate into putrid ichor; and therefore every thing is to be avoided which tends that way. But as the wounded patient is under a necessity of rest, and as exercise of the body conduces much towards the assimilation of the crude aliments into animal juices, (*per* §. 28. numb. 2. and §. 43. numb. 3.) it is thence evident, that such aliments cannot be properly used as are of a hard digestion, but that such are necessary as will afford juices that may be easily concocted and assimilated, otherwise the wound will be supplied with many crude
and

and useless juices; and will receive very little of those healthy parts, which alone being of an animal and healthy nature, are capable of regenerating the lost substance in a wound.

We are therefore in this section directed to such aliments as are of a mild nature, easily digestible, and therefore fittest for the present intention. Water, or flesh broths boiled with oats, barley, buck-wheat, rice, &c. afford such mild nourishment, as is neither inclined to putrefaction, nor of a difficult digestion. Also the meal of those grains well fermented and made into eatables of various forms, may be likewise used; since the viscosity of the meal is thus removed by the fire and ferment. Bread thus prepared or fermented, and especially bisket, with flesh broths not over strong, nor incumbered with fat, will be found very serviceable. To these add emulsions, made by grinding the soft mealy seeds with water, which much resembles the chyle itself. Milk and water mixed in equal quantities in winter, but in summer more water, may be used as a common drink; and milk gently boiled with farinaceous substances, affords a good nourishment. Garden fruits, which are quite ripe, and of a pleasant taste, are very useful in cooling and refreshing the body; but they are best after their flatulency has been removed by dressing with fire. Lastly, all the mild pot-herbs, such as lettuce, endive, spinage, roots of tragopogon, or goat's beard, turnips, parsnips, &c. are excellent, being boiled in broths.

But though all these make a salutary diet, they may be hurtful if taken in too large a quantity at a time; for by that means the wounded patient will be oppressed by too large a quantity of crude chyle mixing with the blood, and not attenuated by exercise, whence the condition of the wound will be altered for the worse. But if the whole quantity of aliment to be taken is divided into portions, of which some may be given every two hours, it will then be easily digested or assimilated, and the nutritious juices thence sent to

the wound will be always of the same nature. But when a large quantity of food is taken only twice or thrice in a day, the blood brought to the wound is over-loaded with crude chyle soon after the meal, but after a longer interval, when the chyle is attenuated into serum, the blood then brought to the wound will be of a different nature than before, whence the condition of the wound will be disturbed by alternate vicissitudes. But on the contrary, abstinence or hunger is to be equally avoided with too much repletion: since hunger denotes that the body wants fresh aliment, and if the blood and juices are not often supplied with new chyle, they become acrid and semi-putrid; as we are assured from the putrid and cadaverous smell of the urine of those who have fasted long. But above all, care must be taken not to let the patient thirst, or want drink, since thirst denotes a driness of the body, and that the juices are either gross and impervious, or mixed with acrid particles, all which must be highly pernicious to the wound, since it requires to be supplied equally in every point with mild or tasteless, and pervious juices: and therefore a moist and cooling diet is here required, to dilute the juices, open the vessels, and render them easily pervious; also to discharge the acrimonious and offensive parts of the blood in the form of urine and sweat.

S E C T. CXCIH.

FROM a knowledge of the patient's constitution, the season of the year, his usual course of life, and the nature of his concomitant disorders, we are taught which of those aliments (192), and what methods of preparing them, are fittest for every particular person.

All that has been said before concerning the regimen of diet, must vary according to the different constitution of the wounded patient; so that no general and certain rules can be given. When the hospitals are crowded with a great number of wounded patients in time of war, and the same regimen of diet is applied indiscriminately to all, many of them perish, who might have been otherwise preserved. All here required, is to preserve the health of the wounded patient when present, or to restore it when absent. But every man has his healthy crasis peculiar to himself; and though the state of the solid and fluid parts of the body be very different, yet are they healthy to each individual person; and therefore what is called the health of the temperature, ought to be particularly regarded. Hence Physicians have distinguished the cold, moist, dry, bilious, sanguine, phlegmatic and melancholy habits, each by their proper signs; and observe that a different and sometimes opposite regimen of diet, is necessary for the cure of disorders in different habits or constitutions of body. Thus, for example, if the wounded patient appears to be of a moist and cold temperament, the use of much thin and diluent liquor is to be avoided, and such are to be used in their stead as strengthen the solids, and quicken the blood's motion: but if, on the contrary, his humours appear thick and compact, and his solid parts firm and tense, denoting him of a warm and dry habit, in that case the regimen which was hurtful to the former, will be here useful. And the like may be said with regard to the other habits of the body. Hippocrates observes, (a) *Carnosis, mollioribus, rubris confert, majorem anni partem sicciori diæta uti; humida namque illorum natura est. Duros vero, graciles, fulvos & nigros, humidioris victu diuturniori tempore uti oportet, nam hujusmodi corpora sicca sunt*: "Those who are of a florid, soft, and fleshy habit, ought to live most part of
" the

(a) Hippocr. de salubri victu ratione, Charter. Tom. VI. pag. 23. 224.

“ the year upon a drying diet ; because they are
 “ a moist nature. But those who are firm, thin, and
 “ of a yellow or swarthy colour, ought to live most
 “ upon a moistening diet ; because the bodies of such
 “ are dry.”

But also the different seasons of the year will require a different course of life, even in the same man. For during the summer heats our juices very quickly corrupt and degenerate ; but in winter very slowly : since the flesh of animals will keep sound several weeks in the winter's cold, when the summer heats would change them in a few days into a putrid and offensive mass. Hence the wise Physicians of old, very carefully distinguished the different methods of diet according to the several seasons of the year : in the winter they recommended a plentiful diet, with the drinking of wine without water, but sparingly ; to eat very few vegetables, and those only which were of a warm and drying nature : and to roast both fish and flesh. But in the summer they approved of much and thin drinks ; fish and flesh boiled, with plenty of tender vegetables. In the spring time they advised to gradually increase the quantity, and thinness of the drink, the substitution of boiled food for roasted, and a gradual diminution of the meals, to prevent any sudden alteration in the body ; and in this manner they went on to the summer diet. But in autumn again they increased the quantity of food, diminished the drink, and increased the strength of the last, until they gradually arrived at their winter diet (*b*). But since the conflicts of war are mostly in the summer time, it is then a miserable practice to supply the wounded with flesh broth only, by which they are extremely impaired ; and though, at the same time, they have a strong desire for acid drinks and ripe fruits, yet are these generally prohibited.

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(*b*) Ibidem, pag. 221, 222. & de victu ratione sanorum, Lib. III. cap. 2. Charter. Tom. XI. pag. 58.

The different age of the patient again indicates a different regimen of diet, as will readily appear from what has been said before.

Usual course of life, &c.] Use, which is deservedly termed a second nature, comes here to be considered. The hardy ploughman, who is used to live on coarse, brown, or black bread, with dried and salted meats, the better to support his body under daily and great labour, if such a man, being wounded, was to be treated only with flesh broths, he would soon be exhausted and killed; and therefore such strong and labouring men ought to be allowed a more solid food. Hippocrates (c) observes, *A multo tempore consueta, etiamsi deteriora fuerint, insuetis minus molesta esse solent*; That things not good of themselves, are usually better dispensed with by such as have been long accustomed to them, than by such as are strangers to the same." In his book *de victu acutorum*, he again extends the same observation, taking notice that men can easily dispense with aliments they have been accustomed to, even though they are bad in themselves; and that, on the contrary, they cannot well bear even good food, to which they have not been used; and the same he also affirms with respect to drink (d). From all which it is evident, that a prudent Physician ought to make some allowance to use or custom, even in things otherwise repugnant to the rules of practice.

The nature of his concomitant disorders.] We have as yet only considered the wounded patient as being in health; but if his juices were in a bad state before the wound was inflicted, or if the wound be at the same time accompanied with another disease, then the whole regimen ought to be directed so as to oppose the bad effects to be feared from the cacochymy or concomitant disorder. If, for example, a putrid scurvy attends, or if the mass of juices incline to putrefaction from an intense fever, the patient should be

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(c) Aphor. 50. Sect. 2. Charter. Tom. IX. p. 87.

(d) Charter. Tom. IX. pag. 58.

then supplied with a milk-diet, oat-meal, rice, & with garden-fruits of the acescent kind: abstaining from flesh-meats, their broths, eggs, &c. But if weakness of the whole habit, and a mucosity of the juices prevail, the languid forces are then to be excited by the use of roast-meats, wine, aromatics, &c.

From an exact knowledge, and comparison of these particulars, we may conclude, what solid and fluid aliments are fittest to give the patient, and what preparations of them are necessary, for a great difference is made in the same food by different ways of dressing. Veal that is fresh affords a broth by boiling which may be given even in cases where the juices are in some measure inclined to putrefaction, especially if a little juice of citrons be added to the broth: but the same flesh being kept for many days in the open air before it is boiled, does then afford a broth that putrefies much sooner. The same veal roasted is still more inclined to putrefaction, the salts and oils of the flesh being rendered acrid by the action of the fire. A crude and mealy diet is pernicious to cold and phlegmatic habits, but food prepared of the same meal by fermentation is allowable. The same may be likewise said of various other preparations of the aliments.

S E C T. CXCIV.

EVERY thing acrid, which too much increases the blood's impetus, must be avoided. Therefore things salt, aromatic, or acrid, with pungent vegetables and wine, are pernicious to wounded patients.

Since all our juices are in their healthy state so mild or smooth, that the blood itself, and the several humours thence separated, (except the urine and bile which become acrid chiefly by their long standing) give no uneasiness to the eye upon being dropt into that

that sensible organ ; and since the lost substance of a wound ought to be degenerated of such juices, it seems the best way to supply the patient with such aliments as are neither acrid nor stimulating in themselves, nor are easily changeable into such a state. For an acrid chyle offends by irritating the wounded part to which it arrives crude, and by too much exciting the motion of the blood and its juices, often occasions the small vessels to yield too much, and to degenerate into a fungous or a proud flesh ; or else the increased motion excites an inflammation, by obstructing the vessels about the surface of the wound, whence the cure will be again retarded ; for all those vessels must be afterwards separated by suppuration.

All things therefore which are stimulating, under any demonstration whatever, are by their own nature pernicious to wounds ; supposing the patient wounded to be in health. Otherwise, if a putrid cacochymy also attends, the taking of acids will then be serviceable and not at all pernicious. Nor ought this aphorism to be so strictly understood, as if a few grains of salt, or a few drops of citron juice, would be hurtful to the patient's broth ; for so small a quantity may restrain the propensity of those aliments to putrefaction, and at the same time can give no offence as a stimulus, and if something of the like nature be not added to the broths, they will quickly be loathed by the wounded patient.

The use of wine is also for the same reasons improper, unless indicated by the custom or weakness of the patient. For many people use themselves to wine, or other spirituous liquors, in great plenty every day, and if such were suddenly deprived of them entirely, they soon languish, and several functions of the body would be disturbed : under these circumstances therefore a moderate quantity of wine may be allowed to be drank, either pure or diluted, as the patient's strength and use may direct.

S E C T. CXCIV.

Substances which easily putrify should be likewise equally avoided: whence broths made too strong, and the alcalescent herbs are bad, as the horse-radish, cresses, cabbages, &c.

We ought not only to consider the nature of the aliment in itself before ingestion, but also to regard the alterations to which it is afterwards subject by the warmth and stagnation in the body. For as we before observed, the nutritious juices prepared from the aliments are conveyed with the blood to the wound, and are in part extravasated into its cavity; whence if their nature was such as to easily putrify, there is great reason to fear, that instead of forming laudable matter, they will be converted into a putrid or corroding ichor. As fish therefore, and especially those of the sea, are liable to a speedy putrefaction, and are not capable of being preserved and eat without much salt, they ought not to be allowed a wounded patient. The strong broths of flesh, and the jellies made from hartshorn or ivory-shavings, frequently corrupt into a stinking liquor by the summer's heat within the space of four and twenty hours; to which may be added, that those thick broths sit uneasy upon the stomach, and are not readily digested. We before observed (in §. 76.) that some plants are of that nature, that when they spontaneously corrupt, they do not turn sour like most other vegetables, but change into a foetid, volatile, and oily alkali; and in some vegetables there naturally resides a sharp, volatile, and alkaline salt, even before they have suffered any previous corruption: such are the horse-raddish, mustard, cresses, &c. all which are pernicious to the wounded, either from their propensity to putrefaction, or from their sharp stimulus and irritation. But more danger is to be feared from those plants which naturally tend to putrefaction

outrefaction, because the same natural inclination to degenerate is already in all our animal juices themselves. But those vegetables, which naturally turn sour, resist the spontaneous corruption or degeneration of our humours, whereas the former promote it. A catalogue of the alcalescent plants, which are offensive in wounds, may be seen in our professor's *Materia Medica*, at §. 76.

S E C T. CXCVI.

SUCH aliments are also improper, which are difficult to be converted into chyle and blood. Such are those which have been salted, and dried, or hardened either in the smoke or open air; such as abound with fat, as pork, fat fish, and geese, ducks, or other such poultry as feed upon sh, &c. lastly, food that is too viscid, as thick pulse, crude farinaceous, substances, and eggs.

People, who work hard at daily labour, eat heartily of the coarsest and hardest food, which they digest very well; nor are they much pleased with the lighter sort of aliments, which are incapable of supporting their strength equal to their exercises: but on the contrary, those who live an idle or sedentary life are much disordered by eating gross or compact aliments, from whence it follows as a general rule, that the diet ought to be proportioned to the course of life. For compact food being difficultly convertible into good chyle, weakens and oppresses the sedentary person; and since those who are wounded are obliged to rest, it will be impossible for them to digest such food into good chyle and blood capable of restoring the several losses of the parts. But in this respect we must always make some allowance for the patient's use or custom, as we observed in §. 193. or such as have been accustomed all their lives to live

on such a coarse diet, cannot live entirely on the softer aliments.

But the flesh of animals, or fish, which have been salted, and hardened by drying either in the smoke or the open air, are much more difficult to digest and convert into good chyle and blood, than those which are fresh; and fat meats are, above all, pernicious and the most difficult to digest, turning very rancid and acrimonious by long staying in the body. If a weak person should eat a great deal of pork or bacon for breakfast, he will in the evening frequently belch up a rancid and fat oil, burning or corroding his mouth and fauces, and flaming upon being spit into the fire so long a time will fat or oil remain undigested in the stomach, nor will the pylorus permit it to escape into the intestines, notwithstanding its fluidity. The same is also true with regard to fat fish, as the eel, salmon &c. especially if the heads of fish be eaten, in which there is often so much oil retained, that it may be thence expressed entire; and tho' this oil then tastes of a smooth and pleasing flavour, yet does it very speedily acquire a most disagreeable and rank quality in the stomach, insomuch that expert Surgeons presently observe a change in the condition of the wound for the worse after the patient has eat such fat substances. For the oily matter being carried to the wound, obstructs the smallest vessels, and becoming rank or acrid by standing, excites an inflammation not easily removed. Almost all sorts of fish are invested with a large quantity of this oily matter, defending their bodies from being penetrated and dissolved by the waters in which they swim, therefore the birds or poultry which feed on fish are also of a bad digestion; for though the indigested aliments are converted into the juices of the animal by the chylificative organs, yet do the juices they form, retain in some degree their pristine nature whence it is observed, that the flesh of animals tastes different, according to the food upon which they live. Ducks, geese, and the like poultry, which feed only upon

upon

upon fish, have the disagreeable smell and taste of those fish, in their flesh and fat. Hares which feed some months on the leaves of the wild colewort, do then smell very disagreeable, &c. so that upon the whole, the patient ought willingly to refrain from such meats.

We must also observe, that all sorts of pulse and crude mealy substances, form a viscid chyle, whose visciduity may indeed be overcome by much labour and exercise of the body; but in quiescent people it produces a multitude of disorders, which we enumerated in speaking of diseases from a spontaneous gluten, p. 71 to 74.

Lastly, although eggs are deservedly recommended as laudable nourishment for restoring weak habits (per §. 28. numb. 1.), especially their whites, when new, and diluted in broth; yet as they are strongly inclined to putrefaction, they ought therefore to be used sparingly; but when they are boiled hard, they are then found to be of a difficult digestion.

S E C T. CXCVII.

TO answer the intentions of (189), such medicines are serviceable which remove the impediments to the consolidation of the wound, (190, 191) exhibited generally in the form of a decoction. These medicines are therefore various, according to the different nature of the impeding causes to be removed; nor is there any one remedy that can be serviceable for all.

Hitherto we have considered the regimen of diet proper for those who are wounded, that sound juices may be conveyed by healthy vessels to the wound, in order to restore the lost substance: but then the wounded patient has been supposed to be well in all other respects; but if there arises other impediments

from a bad habit of body, or from some circumstance in the wound, which prevent the regeneration of the lost substance, those impediments must be also removed. Enquiry ought therefore to be made what the impediments are, and whether they reside in the solids or in the fluids, or in both; or whether they lie concealed in the wound itself, or in the nutritious or circulating juices brought to the wound; or whether the juices are brought to the wound with too great or too little impetus to restore the lost substance. Since therefore the impeding causes may be of so many and different natures, and since the impediments to a wound's healing may be frequently opposite to each other; it is then evident, there can be no universal remedy in these cases, and that they boast vainly who make any such promises. (a) Helmont falsely believing that the matter in wounds became ill-conditioned from an acid, advised, that all vulnerary drinks should contain a latent and volatile alkali; others have again advised differently, whence we have so many and different forms of vulnerary decoctions, celebrated with encomiums; when at the same time, healthy juices being conveyed with a due impetus to the parts wounded, will perform all that can be expected or required. All therefore that Physicians can do, is to remove and correct the known impediments to the wound's healing by proper remedies, leaving all the rest to nature. But the vulnerary medicines are generally prepared in form of a decoction, because their virtues are that way diluted with water, and better communicated to the blood, and thereby equally distributed throughout the body. But how various are these ingredients required in a vulnerary decoction may appear from the following section.

(a) Helmont: *Ortus Medicinæ*, in Capit. *Blas Humanum*, No: 53 pag. 153.

S E C T. CXCVIII.

HENCE therefore the patient is to be treated according to particular circumstances, either with medicines which attenuate, incraffate, cool and ease, or stimulate and quicken, or else open, relax, or astringe the solids, and correct the contrary vice of the fluids; whence remedies are often required of opposite matters.

Attenuate.] If particular circumstances shall demonstrate, that the cure of the wound is impeded from too great a spissitude of the juices, preventing their easy passage through the vessels, it is evident, that the vulnerary medicines in that case ought to be such as divide and attenuate the juices, so that they may pass easily through the vessels which they naturally ought to pervade in a state of health; but it has been shewn before, (in §. 115 to 118.) that this imperviousness of the fluids may be occasioned by various causes, whence those causes will each require their particular remedies to correct or remove them *per* § 134 to 137. From hence again will arise a vast variety in the vulnerary medicines, even for attenuating the juices, which require very different medicines to remove an inflammatory spissitude, than to correct an atrabiliary tenacity, of a cold and glutinous lentor rendering the juices impervious.

Incraffate.] If the juices are too thin, languid and watery, then such medicines are required to incraffate; but such too great a thinness of the juices is either attended with an acrimony, as often happens in scorbutical habits, where the thin and acrid blood breaks out of its containing small vessels in most parts of the body, forming the scorbutical spots or ecchymoses, and then the mild, glutinous, incraffating medicines are required: but when the juices are too thin, and less com-

fact from a too weak action of the lax vessels on their contained fluids, in that case all medicines which increase the action of the arteries on their contained juices, will be proper incrassating and vulnerary remedies, of which we spoke in treating on the cure of a weak and lax fibre at §. 28. Hence again it appears, that under one and the same title are comprised remedies of an opposite nature; for what was serviceable in the former case, is in the latter altogether pernicious.

Which cool and ease.] Such chiefly are those remedies, which consisting of soft and oily parts, involve and obtund the acrimony of the juices: not such as correct any particular acrimony by an opposite nature of their saline parts, but such as contain a soft and oily mucilage, capable of sheathing and mitigating the acrimony of the juices. Such chiefly are all those we meet with in the shops under the title of emollients, which mollify and lubricate the solid parts of the body, and mitigate the acrimony of their contained juices.

Which stimulate and quicken.] When the powers of life are languid, and the juices are disposed to inactivity, coldness, paleness, and viscidities, without any particular or considerable acrimony; in that case, all medicines which increase the languid motion of the blood and juices by an aromatic and grateful stimulus will be found very serviceable; such as wines, spices &c.

Correct the opposite vice of the fluids, &c.] Which vice ought therefore to be first discovered, before we can tell what particular medicines to oppose: for the defect may reside either in the solids, or in the fluids or in both at the same time. The solids may be disordered either by too great or little cohesion of their parts; concerning the remedies for which we spoke in treating of the too lax and rigid fibre: and in treating of the spontaneous vices of the juices, we indicated

ated what remedies were endued with a power to correct their several vices.

To open, relax, or astringe.] Aperients are medicines which give a free circulation to the several juices passing through the vessels; and are of different kinds, according as the obstructing cause may reside either in the solids or fluids. But laxatives or astringents are also to be used according as the fibres and vessels are either too weak or too rigid, as we observed before.

It is from hence therefore evident, that there can be no general remedy, capable of removing all the several impediments which may arise in the cure of wounds; but that particular remedies are required under particular circumstances. Lastly, you have forms adapted to the several impediments, inserted in our professor's *Materia Medica*.

S E C T. CXCIX.

WE are taught which of these medicines are to be chosen from the known nature of the patient's disorder, and the titles of the remedies (197, 198).

After considering the patient's age, sex, habit of body, course of life, and the diseases which have either preceded or at present accompany the wound, we thence draw our indications to determine what is to be done, and by what means or remedies. For example, if a man of tense solids, with an atrabiliary tenacity in his blood, should be wounded, the wound would appear dry, without discharging any laudable matter; and if it be inflicted in the summer time, the patient will be very hot, thirsty, and will make but little of a high coloured and fetid urine: if now the patient drinks plentifully of thin liquors, as of barley or oat gruel, decoctions of borage, bugloss, and the
 O 4 emollient

emollient herbs in whey or simple water, and sweetened with the syrup of violets, citrons, or elder juice &c. if these are drank liberally, and the wound at the same time treated with cloths dipt in the like emollient decoctions, the condition of it will quickly be changed for the better; its dryness will go off, the diluted juices will pass freely through the relaxed vessels, and the cure of the wound will happily succeed. But, on the contrary, if another person of a pale, cold and lax habit, be wounded in the winter time, leading an unactive life, and the blood and juices abounding with a lentor or mucous matter, the wound will in that case appear pale, cold, and slightly tumified, and will almost constantly remain in the same state: now this person be treated like the former, the condition of the wound, and of his habit of body, will be rendered much worse; but if he is supplied with a infusion or slight decoction, *Ex rad. caryophyllatæ, imperatoriæ, helenii, angelicæ, contrayervæ, serpentariæ virginianæ, &c.* with the addition of a little wine, he will in a few hours after taking them, perceive warmth throughout his whole body, followed by sweat; the pale colour of the wound will then be inclined to a red, the flaccid parts will in a manner revive again, the lost substance will be reproduced, and the wound healed. If a wound be accompanied with a violent fever, thirst, &c. bleeding, and a decoction of tamarinds, with wood-sorrel, &c. will be serviceable. But when the impeding cause is latent, and not easily understood, and the patient's strength in the mean time remains entire, in that case may be given plenty of decoctions. *Ex rad. chinæ, sarsaparillæ, scorzonæ, sisari german. &c.* for these dilute, attenuate, and open without violence, relax the vessels and render them pervious, so as to restore the equal circulation through them, while at the same time they discharge many of the offending humour either by sweat or urine, which would have proved injurious, if retained in the body. And this is all that

can be done towards the consolidation of a wound by
 rt.

S E C T. CC.

THE air of the patient's chamber should be always pure and free from putrid exhalations; that which is dry and moderately warm or temperate is the best, and it should be frequently renewed or changed for fresh air.

When a great number of wounded patients lie together in an hospital, the air is filled with putrid exhalations, which affects all of them, and kills many who might have been otherwise preserved: such places should therefore have the windows often opened, and the air changed or blown out to remove the putrid exhalations. It is indeed often advised to permeate the place for this purpose, but changing of the air is much more serviceable to the diseased. But above all, those patients are observed to suffer most for want of fresh air, who have wounds in the heads, as we are assured from observations. The temperature of the air ought to be moderate and refreshing as in the spring, for a cold air is always pernicious to the wounded, because the naked parts of wounds were never before used to the contact of so cold a medium. Hence Hippocrates says, *(a) Ulceribus frigidum mordax, cutim obdurat, dolorem non suppurantem facit, nigredines, rigores febriles, convulsiones & tetanos facit*: "That sharp cold hardens the skin of ulcers, excites pain without suppuration, with feverish chills, lividness, convulsions and cramps." But it is also necessary for the air to be dry as well as warm, because a warm air that is moist has a strong tendency to putrefaction; for in such an air the flesh of animals prepared by the butcher corrupts in a short time. We may indeed
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(a) Aphorism. 20. Sect. 5. Charter. Tom. IX. p. 205.

by art temperate the air of the patient's chamber a pleasure; the too great coldness and moisture thereof may be corrected by a large fire, made especially of aromatic woods; but if the air be too hot and dry it may be rendered agreeable, cool and moist, by frequently sprinkling cold water upon the floor, or by strewing elder flowers, lime flowers, or willow branches dipt in water, in several parts of the room, and then the thermoscope and hygroscope will indicate the temperature of the air.

S E C T. CCI.

THE bowels are to be kept open by the use of emollients, laxatives, and eccoproticks.

We have here nothing to do with strong purges only the body is to be kept open, that the patient may ease himself without any great pain or fatigue for we sometimes see men strain so violently in discharging their fæces, that they look almost black in the face by the long retention of the air in the lungs from whence may frequently arise a fresh hæmorrhage in the wound, or a laceration of the parts wounded but lately conjoined, especially if they are seated near the anus. It is upon this account, that those who are cut for the stone, or for a fistula in ano, are usually first treated for several days before the operation with lenient purgatives and clysters, to empty the large intestines of their fæces; after which they are for a while only nourished with broths, which afford good aliment without leaving any fæces, so that they may live thereby for a considerable time after the operation without straining upon the stool: whence Hippocrates observes (a), that it is prejudicial for a wounded patient to be constipated.

(a) Lib. I. de morbis, cap. IV. Charter. VII. pag. 535.

If the fæces are kept soft by lubricating the intestines, they will not only meet with a quick and easy excretion, but they will be also discharged without any great force; but in people who are of a tense and dry habit of body, the bowels are often violently constipated, because in those all the succulent parts of the fæces are absorbed by the strong power of the intestines, so that they become dry, compact, and hard, and the intestines being at the same time not sufficiently lubricated with their proper mucus, the fæces are therefore very difficultly excluded. Hence fat broths, emollient herbs and decoctions, sweet express'd oils, &c. are very well adapted to lubricate the passages, and mollify the fæces, to procure them an easy discharge. The same substance also injected in the way of a clyster, are serviceable for the same purpose, especially if the fæces are lodged in the larger intestines, then they immediately reach the parts affected, which would take up some time before they could arrive there, after being taken by the mouth, and then there is also some danger of the patient's being seized with a sudden tenesmus in the former method, which would occasion him to strain violently.

After these emollient and lubricating remedies have been used some time, either alone or mixed with such things as purge with a slight stimulus without disturbing the body, the bowels will keep open; whereas it has been observed, that after the use of strong purges the patient will be frequently constipated. Medicines which produce this effect are termed eccoproticks, because they only discharge the fæces contained in the large intestines, a catalogue of which is given in the Professor's *materia medica*, answering to this section. It is not whether or no there are any remedies strictly answering to this title, by only moving the fæces, is much to be doubted, for all of them given in a large quantity solicit an excretion of the intestinal juices; thus the new juices of garden fruits, the must or new wines thence made, with honey, tamarinds, cassia, manna,

manna, &c. being taken in a large quantity, or often not only loosen the bowels, and discharge the contained fæces, but also sollicit a considerable discharge of their humours. But the medicines which produce the last effect are properly termed purgatives, as the ancient Physicians have very judiciously observed and distinguished. It was the opinion of Asclepiades (b) that purgatives wasted the body, and then discharge the juices which were not before in the intestines. And Theffalus concludes, as appears by his words cited by Galen (c), that the substance of the body is changed into corruption by purgatives, which afterwards discharge them either upward by vomit, or downward which opinion he endeavours to prove, by an instance of a wrestler of a good habit of body, who by taking a purge, discharged a great deal of corrupt matter which he thought could not pre-exist as such in the robust and healthy person. Galen, who imagined that purgatives attracted the matter in the same state as before existed in the body, exclaims highly against this opinion, though his arguments are at the same time insufficient to disprove it. It is certain, that scammony being given to the most healthy person, dissolves the blood into a putrid water, which is discharged by the intestines, insomuch that the whole body may be wasted by the repeated use of it; and then the paleness, weakness, collapsed vessels, &c. sufficiently demonstrate, that the corrupt juices discharged, were not so conditioned before in the body, but that the healthy juices were first corrupted by the virulency of the medicine, and then discharged from the body.

Since therefore all medicines which are called eccorrupticks will purge, if given in a large dose, and many purgatives will in a small dose only move, or gently irritate the intestines to discharge their contained fæces; it is evident, that the same effect may be
procure

(b) Galen. de natural. facult. Lib. I. cap. 13. Charter. Tom. V. pag. 21.

(c) Galen. advers. Julianum libellus, cap. 8. Charter. Tom IX. pag. 391.

cured from both, provided the dose be small, to avoid giving any disturbance to the body, and to prevent any great change in the humours, the present sign being only to keep the bowels lax or open.

Hippocrates has carefully distinguished betwixt purges and laxatives; for after speaking upon expectation, he says, (d) *Quicunque enim dolores ex his locis cessant per sputorum expurgationes, neque per alvi sectionem, (πρός τὴν τῆς κοιλίας ἐκκόπρωσιν) neque per dietam & purgationes, (φαρμακείας) purgationem concitaturus esse, sciendum est: "Whatever pains do not cease or remove by the discharge of spitting, nor by a looseness, phlebotomy, diet, and the use of purgatives, we may conclude they will terminate in suppuration."*

S E C T. CCII.

SLEEP is to be procured to the wounded patient by the use of anodynes, with narcotics and a moist diet.

The loss or consumption of the most subtile juice of the body, the nervous fluid, can be restored naturally but one way, namely, by the continuance of the vital functions, while all the animal actions cease in a quiet sleep. When a man is fatigued with violent exercise, or exhausted by profound meditation, his body will seem heavy and uneasy, his intellects grow dull, and that even though he be supplied with the best aliments, if he is not also recruited with sound sleep. But after sleep the body recovers its agility, the mind becomes serene, and easily perceives by the organs of sensation, so that though the aliments supply the matter for recruiting the spirits which are daily exhausted by the actions of life and health, yet that matter is chiefly prepared during the time of sleep, so as to fit it

(d) In Prognostico, Num. 52. Charter. Tom. VII. pag. 646.

it to supply the place of the nervous juice before exhausted. For in sleep the respiration becomes stronger, the action of the heart and arteries become more powerful and equable, and all the juices are so regularly conveyed to their respective parts, that nutrition is best performed at that time, since the causes which digest, form, and apply the several humours, do at that time act with the greatest freedom or liberty; and perhaps this may be the meaning of Hippocrates (e) where he says, *Anima enim vigilat, & quum quidem corpori subministrat, haud ipsa sibi vacat, sed singulis corporis partibus quandam partem subministrat, sensibus nimirum, visui, auditui, tactui, ambulationi, actioni, omnique corporis cogitationi, ipsa vero mens sui officii non est. Quum vero corpus quiescit, anima movetur, & ipsa corporis partes subrepens domum suam gubernat, omnesque corporis actiones ipsa obit*: “ When the mind is awake, it not only governs the body, but is also at the same time careful of itself, and performs something in every part of the body; being also subservient to the senses of seeing, hearing, feeling, walking, thinking, and all other actions of the body, all which are not the actions or offices of the mind alone which is here passive; but when the body is passive or quiescent, then the mind acts and rules the several members of its habitation the body all whose actions are then obedient to it.” It is therefore evident, how pernicious too much watching must be to those who are wounded, and how necessary sleep is towards the regeneration of the lost substance and the cure of the wound. If therefore the patient wants sleep, that is to be procured by anodynes, which remove pain; for watching, especially in the wounded, generally arises from pain and uneasiness, though great cares and intense passions of the mind may also occasion watchfulness: the remedies which remove pain may perform it three ways, either by removing the cause in the body, which excited the uneasy sensation

(e) De Insomniis, cap. 1. Charter. Tom. VI. pag. 511.

on in the mind, which we call pain, or by disposing
 the part of the body to be not at all or less affected
 by the exciting cause of pain; or, lastly, by removing
 the sense of pain itself, though the cause thereof, and
 the condition of the affected parts, remain the same;
 as when, for example, an inflamed part is painful, the
 cause of the pain is the inflammatory spissitude and
 imperviousness of the juices hesitating in the vessels,
 while at the same time the blood and lymph is urged
 forcibly by the action of the heart and arteries to
 the obstructed vessels. Every thing therefore which
 can dissolve the blood, and render it pervious, so as to
 flow easily through the vessels before obstructed, will
 remove the cause of pain, and consequently the pain
 itself. Thus if by the application of emollient cata-
 plasmis or fomentations the solid parts are so relaxed,
 as to yield easily to the distending causes, without
 danger of rupture, then the pain will either vanish, or
 be greatly diminished, though the inflammatory spissi-
 tude and impetus of the blood remain the same.
 Lastly, if none of those applications are used, but the
 causes of pain, and the condition of the affected parts
 remain the same, yet if a grain or two of opium be
 given to a person not accustomed thereto, he will
 not be sensible of any pain, though the exciting
 causes continue to act as before. Every thing there-
 fore which removes pain by any of these three ways
 is termed an anodyne; though by custom those only
 are called so, which either remove the cause of pain,
 or else dispose the affected parts to be not at all, or
 at least less, affected by the same cause, those being
 generally termed narcotics or stupifiers, which only
 take off the sense of pain, without either removing its
 causes, or producing any change in the parts affected.
 But we find that formerly narcotics were also termed
 anodynes; for Cœlius Aurelianus (f), treating of the
 tooth-ach, says, *Multi autem veterum Medicorum ac-*
tionis tempore ea medicamina adhibenda jusserunt, quæ
anodyna

(f) Morb. Chronicor. Lib. II. cap. 4. pag. 373.

anodyna Græci vocaverunt; nos indoloria dicere poterimus, quæ aiunt nocturno tempore adhibenda, profecto sensum, non dolorem auferentia: “That many of the ancient Physicians advise the use of those remedies which the Greeks called anodynes, when the pain is coming on; but we may rather call them anodynes, which, being given over night, act not by removing the pain but the sensation.” And so Celsus likewise says (g), *Anodyna vocant, quæ somno dolorem levant. Quibus uti, nisi nimia necessitas urget, alienum est:* “Those are called anodynes which ease pain by procuring sleep, which ought not to be used but in cases of the last necessity.”

Now the chief cause of pain in a wound, is either the distention of the parts yet cohering, while the divided lips are drawn back on each side, or else the tension of the nervous fibres, overstretched by the retrocession of some large trunk divided, and distracting the smaller lateral nerves; or else being half divided or punctured, the sound fibres are overstretched; or lastly, from an inflammatory tumour distending the bottom and lips of the wound, or else the irritating acrimony of the corrupt juices, extravasated within its cavity. Anodynes therefore are every thing which remove the cause of pain, by dilating, relaxing, mollifying, correcting, or obtunding, or by dispersing the distending tumour; or, lastly, which so change the affected parts, that the cause of pain cannot excite that uneasy sensation in the mind, which is so called. All these are reduced to their proper heads, in the *Materia Medica* of our learned professor.

A moist diet.] All farinaceous seeds bruised, will afford a good deal of oil by a strong expression; and being ground with water they form emulsions, in which the oil retains its mild and smooth quality without danger of growing rancid. A moist diet may be therefore composed of these or the like farinaceous substances formed into decoctions with water,

milk,

ilk or broths; by the continuance of which diet the most acute and obstinate pains are mitigated by relaxing the solids, and meliorating the disposition of the juices.

[Narcotics.] If the pain neither removes nor lessens by the preceding remedies, or if it be so severe as not to be tolerable without imminent danger, recourse must then be had to such medicines which take off the sense of pain from the mind, 'till the causes thereof can be removed, which cannot yet be effected. For the most intense causes of pain may subsist in the body without any sensation thereof in the mind, as appears in apoplectic patients, who may be burnt with fire and not feel it. There are several remedies which possess this power of stupifying, as the Hyosciamus, Scellanum, Datura, &c. all which are too much suspected to be trusted in practice, especially to be given inwardly, because they so much disturb the animal motions. But the use of the poppy is much safer, and approved by long experience; yet the European poppies being less powerful, are to be taken in a much larger dose than the Asiatic, the inspissated juice of which is so well known in the shops by the name of opium, and if prudently administered in a just dose, effectually quiets the pain, which will notwithstanding return again in a few hours after, when the force of the medicine is spent, from the causes of pain continuing to act. Galen (*h*) will have opium to be hurtful by a too cold quality; which opinion has been, after him, received by many others, who therefore used it with great timorously, endeavouring always to correct its supposed coldness by the use of the warmest aromatics, and some have condemned it together as a deadly medicine. But whoever has once tasted the warm bitterness of opium, will readily believe that the bad effects of opium are falsely attributed to any cold quality; and so infamous was this excellent medicine for a long

VOL. II. P time,

(*h*) Method. medendi Lib. XII. cap. 8. Charter. Tom. X. pag. 10. & alibi plurimis locis.

time, that the generality of Physicians rejected and abhorred the use of it; so that Paracelsus derived great part of his fame from Opium, which was then in disuse, he performing wonders in the cure of diseases with his Laudanum. The Asiatics daily use opium in large quantities without damage, and especially those use it the most freely, whose religion prohibits them from the use of wine; and even they who condemn opium most, made no scruple to use it in the capital compositions of the shops, as in Theriac Mithridatium, Philonium, &c. which contain a large quantity of this drug. Others again, for their own profit, exhibited opium to their patients, concealed among other ingredients, though at the same time they publicly condemned it, that others might think they used arcana to perform what was done by the opium only. It was indeed the opinion of most Physicians, that the medicinal power of mithridate, theriaca, and the like, did not arise from the virtues of all the ingredients conspiring together, but that the intimate mixture of so many different drugs produced a quite new and distinct remedy, deriving its virtue not from the power of the ingredients severally, but from the intimate union or combination of them; whence the antient theriaca came into such general esteem, and that was most preferred which had been longest made. But notwithstanding this reasoning may at first view seem conclusive, yet upon more mature consideration, the principal virtue of these capital medicines will be found to arise from the opium, notwithstanding the warmth of their aromatics. The mithridatium of Democrates, which is older than the rest, contains so many different ingredients, that Pliny says of it (i), *Quo deorum perfidiam istam monstrante hominum enim subtilitas tanta esse non potuit: ostentat artis & portentosa scientiæ venditatio est*: Which may be translated, “the gods first discovered this perfidious mixture, for the wit of man could never be equal to it, being”

“mer

(i) Lib. XXIX. cap. 1.

mere specious shew of art, and a monstrous boasting of knowledge." But Andromachus, who was one of the chief Physicians to Nero, not only retained all the ingredients, but a few, adding some others, especially the flesh of vipers; and thus he formed a new antidote, which he denominated theriaca, from the viper's flesh in the composition. He wrote a book in Greek verse, which he dedicated to Nero, wherein he describes and enumerates the ingredients of theriaca, which he also denominates *σαλυνόν*, or pack: and no wonder that it should be so called, for when Andromachus added three times as much opium as was in the former composition, whence the name of Democrates's mithridate was effaced, while the theriaca only was extolled with infinite praises; so much that it has retained its reputation all along, though so many ages, which is an evident argument, that opium was safely and frequently used to good purpose, even in those times in which it was condemned almost by the whole tribe of Physicians.

All the preparations of the flowers, leaves, or juice of poppies, that are met with in the shops, may be so used, as only to obtund or lessen the sharpness of the sedatives, or else in a larger dose, so as to produce a profound sleep. Thus it frequently happens, that a small dose of this medicine will quiet the pain, without occasioning sleep, only the patient perceives a sort of calmness both of body and mind, which they who experience the comfort of cannot describe in words. But yet opiates do not affect all people alike, even though exhibited in the same quantity; and therefore when a Physician is acquainted with the patient's particular habit and disposition, with respect to these medicines, it will be most expedient to order a few grains of opium, diluted in some vehicle, to be given by small doses, every quarter of an hour, 'till the pain is eased. But it must be observed, that the same quantity of opium taken all at one time, will produce a greater effect than taken at repeated doses; and those

who have been long accustomed to take it, receive no benefit from it, unless the dose of it be gradually augmented; and that many people take daily a large quantity of opium without harm, by thus gradually augmenting its dose, is proved by certain observation and experience. In our professor's *Materia Medica* you will meet with various forms, in which this medicine may be exhibited according to particular circumstances, or as a greater or lesser effect is required though it has generally one inconvenience, that makes the patient costive, which may be easily remedied by a laxative clyster.

Remedies of this kind do also give surprizing relief, by external application to the parts in pain hence we so frequently meet with an addition of the leaves of henbane, garden-poppies, &c. in the composition of emollient cataplasms and fomentations.

S E C T. CCIII.

THE mind should be chearful, venery is to be avoided, and rest recommended to the patient.

Since all violent passions of the mind produce such extraordinary changes, and disturb all the functions of the body, they must ever be pernicious to a wounded patient; but that serenity and quietness of mind which is undisturbed by fear or remorse of conscience but is fed with hope, will be much the best in the case; but excessive joy is equally pernicious, with other violent passions of the mind. Sanctorius and others, who have wrote *de medicina statica*, observe that joy makes a body perspire much, and seem light. But this lightness of body is a sign of a very free circulation through all the vessels, with a ready exercise of all the functions, which makes a good state of health.

Vener

Venery is to be avoided.] For nothing more shocks the nervous system than this exercise, whence it is reputed hurtful to wounded people by the general consent of all Physicians, and as we are taught by woful experience; for in §. 172. numb. 2. is given an instance, where a bare emission, without the act of co-ulation, has induced the most violent symptoms, and even death itself; therefore every thing which excites venery, should be excluded from a vulnerary diet, such as oysters, lobsters, crabs, &c.

But that rest is necessary to a wounded patient is self-evident, because motion destroys those tender vessels which are lately regenerated in the wound of a mucous consistence.

For it is necessary for the healthy juices to be conveyed in a due quantity, and with a proper force, to supply the lost substance; it is also necessary for the receiving vessels to be in such a condition as may fit them to imbibe and transmit each their proper juices, which ought naturally to flow through them. Hitherto, from §. 192, we have been treating chiefly concerning what regards the diet, or regimen and use of medicines, in order to procure good juices to be transmitted to the wounded parts. It now remains for us to treat concerning the necessary disposition of the wounded vessels, required to supply the lost substance, and procure an union of the parts wounded.

S E C T. CCIV.

IN order to retain the vessels in their necessary condition (189), and to prevent the juices from corrupting in the wound, so as to impede healing (described in 189 to 192) the air is to be excluded from the wound, which is to have its whole surface covered with some soft vulnerary balsam, its cavity is to be filled with scraped lint, to procure an equable pressure, and nerves or ner-

vous parts are to be treated with medicine agreeable to their nature.

After the infliction of a wound, the ends of the divided vessels recede from each other, are compressed and resist the course of the juices propelled through them, whereupon an inflammation begins to arise in the lips and bottom of the wound, and then follows suppuration, or conversion of the juices into matter while this is performed, the extremities of the divided vessels are gradually extended from the whole circumference and bottom, towards the center of the wound and their appearance is much like a mucus, from whence is supplied the lost substance (*per* §. 158.) it is therefore evident, that incarnation requires the vessels to be of a due tenacity, that their pulp-like extremities may be soft enough to yield to their contained juices; and it is also necessary for those juices which are extravasated in the cavity of the wound, digest into laudable matter, otherwise if they become acrimonious, they will corrode and destroy the fleshy pulpy substance with which the cavity of the wound is filling; but both these intentions may be obtained by excluding the air, since we are taught by experience that the parts of animals will keep a long time without corrupting, only by preventing them from having any communication with the air; whereas they will on the contrary, putrify in a few days if exposed to the open air. The flesh of goats and poultry being roasted, minced into small particles, and then immersed in melted butter, the whole being afterwards deposited in a close cask, has kept good for above six months, in a ship returning from the Indies, inasmuch that they have retained their original relish perfectly agreeable. (a) It must be observed, that by giving the air a free access to the wound, it destroys the incarnation.

(a) Boyle de utilitate Philosophiæ Experimentalis Exercitatio IV. pag. 184.

on, by drying up the tender extremities of the growing vessels, which will occasion a fordes of the dead extremities, which must be digested off before the wound can heal; and for this reason it is, that many have imagined that some venomous quality resided in the air, since the bare admission of it so much altered and impeded the healing of the wound; and for the same reason too, the most experienced Surgeons have commended the practice of dressing wounds but seldom.

The whole surface of the wound ought therefore to be so covered and defended, as entirely to exclude the air: and this is obtained best by the use of vulnerary balsams; and especially the natural balsams, which all retain a thick adhesive quality, with a mild aciciness joined with an acid, both which resist putrefaction, and at the same time are not offensive by their stinkiness, because inclosed in a soft oil. This we know from a chymical analysis, which procures an acid liquor, with a thin, fragrant, and aromatic oil, from all natural balsams, while the thick resinous part remains behind in the bottom of the retort. When these balsams are gently warmed, and applied in a moderate quantity, so that they may spread equally over the whole surface of the wound, they not only cover and defend the extremities of the tender vessels, so as perfectly to exclude the air, and prevent the parts from rotting, but they also preserve the extravasated juices from putrifying. From what has been said it appears, that a small quantity of any balsam will suffice for all the purposes of a wound, and that those run to a bad practice, who overload a wound with too great a quantity of vulnerary balsams, which are then effect foreign bodies in the wound, preventing the consolidation of the divided parts. In our professor's *Materia Medica*, you will meet with a great many natural and artificial balsams, enumerated for this purpose, which all act and prove serviceable almost in the same manner.

After the incarnation of the wound, we must endeavour to prevent the common integument of the skin from being formed too soon in the wound, that the soft, pulpy, and growing vessels, covered with some mild balsam, and forwarded with warmth and moisture may easily yield to the distending juices, whence they will be increased in all their dimensions; but if over-dilated, they will admit of foreign or gross humours which will occasion the surface of the wound to degenerate, and become unequal with a substance usually called proud flesh: but this may be prevented, by making such a moderate pressure upon the surface of the wound, as will supply the defect of the restraining skin; and that may be best obtained with scrap'd linen that is soft and dry, and lightly spread with some mild balsam, on that side which is to be applied to the wound, whose cavity ought to be filled therewith; and after all, a gentle pressure is to be made, by retaining the dressings upon the surface of the wound, with plaster and bandage, being careful at the same time to prevent the pressure from being so strong, as to restrain the growth of the tender vessels, and prevent the free course of the juices through them. The same gentle pressure will also prevent the membrana adiposa from rising up above the surface of the wound, by the force of the contracting skin, so as to form proud flesh.

S E C T. CCV.

WHICH dressings (204) are best retained on the wound by plasters, only serviceable for this intention of healing the wound, by their soft tenacity without acrimony.

This will be hardly believed by Surgeons, who generally attribute the happy cure of wounds to their plaster, of which every one has a particular kind valued as a secret. If a wound is conditioned according

to the preceding paragraphs, it may be cured by the application of any plaster that is mild and inoffensive, or which contains nothing injurious to the wound, or does not stimulate too much, nor impede the incarnation by any other means. That this is the case, may appear, inasmuch as every one makes a happy cure, each by their own plaster, though very different from each other, provided the wounds be in other respects well conditioned. It is indeed true, that the plasters applied to the skin, may be not only adhesive, but also contain such ingredients, as become active by the heat of the body to which they were applied, and insinuating into the bibulous vessels are put into motion, so as not only to act upon the part itself to which they are applied, but also to diffuse their efficacy throughout the whole body, and produce a considerable alteration in the habit; such, for example, are mercurial and blister-plasters, with others of the like kind: But this is a consideration not proper for the present time, since the wound, as here considered, is to be treated only with plasters that are soft and tenacious. On this account it is that the emplasters are so serviceable for this purpose, which are composed of lead, and its several calces, combined with oil, and boiled to a due consistence, when at the same time any of the fat substances applied inflame the skin. The vulnerary plasters for this purpose are therefore those, *de minio*, *diapalma*, *diapompholygos*, *de cerussa*, *defensivum rubrum Vigonis*, and many others of the like kind, which all act in the same manner.

S E C T. CCVI.

THE several juices brought to and extravasated within the cavity of the wound, combining within the half dead fibres, and obstructed or tumified vessels, occasions the formation of matter, ichor, fordes, or proud flesh.

The wound is to be carefully inspected at every dressing, to observe whether any alteration is made on its surface, that may impede its incarnation and cure; for if it appears equally red, clean, and moist we know that the vessels and humours are in a healthy condition, and fit to promote the cure; but if the wound appears dry or foul, we then know that it cannot be cured before it is cleansed, and the vessels restored to their office, of equally transmitting the juices to every point of the surface in the wound. The impediments to its cure arise either from the extravasated juices corrupting, or else from an obstruction and tumour in the vessels, or from both together at the same time. Many parts of the wound may be in some measure cut off from the rest, by which means the circulation through them is destroyed, notwithstanding their adherence to the living parts, whereupon they mortify, and must be separated from the rest, because as long as they continue in the wound, they are as foreign bodies impeding its cure. But after the mouths of the vessels in the surface of the wound begin to discharge their juices by stagnation and warmth of the parts, with an exhalation of the most subtile vapours, they are changed into a smooth unctuous matter called pus, which is then good conditioned, as we observed, §. 158. numb. 7; but this being left too long in the wound, may be injurious to it, by corrupting and turning acrid. But when the surface of the wound is moistened with a thin ichor instead of laudable matter, it never heals or consolidates rightly so long as that appearance continues. That a wound in this condition, may be known by the appearance of such a thin matter, after the wound has been covered for twelve or more hours with convenient dressings; for if the wound be cleansed and dressed, and then opened again the hour afterwards, it will be found to contain a liquor much thinner than matter, which yet would be converted into matter by standing there. By the name of ichor we understand a thin liquor, generally of an acrimonious quality.

quality, which by stagnating in the wound, never changes into laudable matter, but always becomes more acrimonious. Such an ichor is always formed either of the extravasated juices not changed into laudable matter, or it may also arise from laudable matter remaining too long in the wound; for then it is again attenuated, and rendered acrid. Thus, for example, when a part has been suppurated and rendered equally soft, if it be opened in time by the lancet, laudable and thick matter is discharged; but if the matter is too long confined within the parts, it becomes again attenuated, and converts itself into sanies or foul matter, as appears by opening the part a considerable time after the suppuration has been completed.

But fordes are formed in a wound, either from the half-divided parts, or from the dead parts not yet separated from the living. or else from the distended vessels impervious to the juices; under which circumstances the surface of the wound does not appear clean and red, but white and almost like lead: and unless the sordid be separated from the living parts by suppuration, they change from a white to a yellow colour, and sometimes even to a brown, in which case the wound is supposed to be the worse conditioned, as the colour inclines more from a white to a dark or brown.

But spongy or proud flesh is chiefly formed when the surface of the wound is not equally compressed, and the skin at the same time too much presses the adjacent parts, whereupon the panniculus adiposus rises up into a tumour, and quickly degenerates into a fungous flesh, as we observed in §. 558. numb. 5; and this especially, when the impetus and velocity of the circulating juices is too much increased by a fever, for then the dilated vessels speedily rise up, if they are not prevented by a due compressure; but we see almost in every part of the body, that when the equal and restraining pressure is removed, the fibres and vessels

vessels rise up or tumify, where there is the least resistance. Thus in wounds of the head, after the application of the trepan, if a portion of the resisting cranium and dura mater are removed, the substance of the brain rises into an extraordinary fungus, or excrescence. If again the integuments or muscles of the abdomen are divided by a wound, without injuring the peritonæum; if the parts are not retained together by bandage, the abdominal viscera will be quickly pressed to that part where there is the least resistance so as to dilate the peritonæum, and form a hernia. The origin therefore of proud flesh in wounds, is only the natural consequence of a diminution in the equable pressure, which ought to be made upon the growing parts.

So long as all these continue in a wound, they impede its consolidation, and therefore they ought to be removed as foreign bodies; the method of performing which is taught in the following paragraph.

S E C T. CCVII.

WHICH impediments (206) are usually remedied, by digesting, absterging, corroding, or drying medicines, and frequently by compressure.

When a skilful Surgeon observes the surface of a wound degenerate, so as to appear not equally moist, red, and clean, but beset with white, yellow or brown fordes, they then know that the best balsams can be of no service towards curing the wound, before nature has performed her office, by suppurating and freeing the corrupted from the sound parts; but the subjacent living vessels cannot easily cast off the adhering and incumbent impediments, and therefore the half-dead substances remaining too long confined in the wound, they corrupt and degenerate into a worse condition.

In this case therefore the Surgeon applies such remedies as mollify the fordes, and at the same time loosen them by an absterfive or saponaceous quality, irritating the subjacent live parts by a gentle stimulus, to throw off the incumbent, sordid, and dead parts, which medicines are generally termed digestives by the surgeons. Thus for example, they take any native balsam, and dissolving it in the yolk of an egg, so as to take off its oily tenacity, and render it miscible with water, to which they then add a small quantity of honey, which by its saponaceous quality divides and loosens many concretions. Such a medicine being spread upon pledgets of lint, and applied to the sordid surface of a wound, so mollifies and loosens the morbid parts, that by the formation of laudable matter, they are separated from the sound parts, and the wound becomes clean. Hippocrates has beautifully indicated the use of such remedies in impure wounds, when he says, (a) *Pinguis inflammatis non conferunt, neque sordidis, neque putrescentibus. Verum ad inflammata profunt frigida, ad sordida vero & putrescentia, acrida, & quæ morsum quemdam excitando purgant*: That fat medicines are not proper, either for inflamed, sordid, or putrifying parts: but the parts inflamed are best treated with cooling applications; but the sordid, and putrifying parts are best removed by acrid and digestive remedies, which cleanse, and, as it were eat their way." And in another place he observes, that the healthy juices brought by the vessels to the wound, easily wash away or separate the sordid parts mollified by these remedies; for, says he, (b) *Siquidem ulcus occludere vel implere opus sit, tumefacere juvat, &c. Cibis enim recreata caro illam, quæ a medicamento corruptruit, propellit, & una cum natura debellat*: When it is necessary to fill up, or incrust and heal the ulcer, it is proper to augment the influx of the juices, &c. For the new flesh formed of the alimentary parts,

(a) De affection. cap. 10. Charter. Tom. VII. pag. 631.

(b) De locis in homine. cap. 13. Charter. Tom. VII. pag. 372.

“ ments, throws off that which was corroded by the
 “ medicine, and assists nature in curing the wound.”

Absterging.] Abstergents are remedies a little more sharp than those called digestives; and therefore if a little myrrh, aloes, or Venice soap, be added to the preceding mixture, we shall have an abstergent medicine, differing only in degree, from a digestive, having a greater stimulus.

Corroding.] Escharotic or corroding medicines are still much stronger than the last, destroying the parts in contact, and forming a crust upon the surface of the wound wherever they are applied; under which crust or eschar the living vessels, and their contained juices do, by their impulse, gradually separate and expel the dead parts from the living. All these medicines do not themselves procure a separation of the morbid from the sound parts, for that is the work of nature only. But they have this use, that they do in a moment, or almost instantly upon contact, deprive or cut off the vital influx of the humours from the obstructed and dilated vessels, forming the fordes of the wound, and which obstinately resisted the action of the milder abstergents: hence they induce a sort of gangrenous crust upon upon the surface of the wound, which is afterwards treated with the softest digestives, to mollify the eschar made by the caustic, that it may be cast off from the living parts, by the action of the subjacent living vessels to which it adhered, and that the surface of the wound may thus be rendered clean. Hence it is evident, that prudence is required in the application of these remedies, not to use them too often, unless the wound shall still appear foul after the separation of the eschar. They therefore judge wrong who think that corrosives only are capable of cleansing a wound, since they barely lessen the fordes, by converting them into a gangrenous crust, which must be afterwards mollified and separated from the sound parts by suppuration; even a repeated use of these caustics will destroy the sound or living parts as well as the

morbid;

morbid; whence the fordes will in that case be increased
 instead of being lessened. This circumstance is well
 observed by Galen, when he speaks of a Physician that
 was surprized the daily use of corrosives to a sordid
 ulcer did not lessen but increase the quantity of foul
 matter, and therefore he injudiciously used a stronger
 medicine of the same tribe; but with ill success; for
 the more he increased the acrimony of the medicine,
 the more of the subjacent flesh he destroyed, and a
 greater quantity of fordes was procured (e).

In the *Materia Medica* of our professor, these cor-
 roding medicines are distinguished into various classes,
 according to their degree of strength or acrimony.
 Those are the most powerful which consist of a very
 strong acid, combined with a metalline basis, among
 which the lapis infernalis, or causticum lunare, is the
 most in use, composed of the strongest, or most con-
 centrated spirit of nitre, and the purest silver com-
 bined together, and formed into a solid of various
 shapes, which renders it almost of all caustics the most
 safe and easy of application. For it must be observed,
 that other caustics act equally upon the whole surface
 of the wound, but the lapis infernalis may be applied
 only to a single point of the surface, without spread-
 ing; and it makes an eschar the very minute after it is
 applied: it will therefore produce a greater or less
 effect, according as it lies a longer or shorter time up-
 on the part before its removal; so that the inequalities
 of the parts may be thus reduced to a level best of all,
 by the lapis infernalis, or lunar caustic.

The eschars formed by the application of caustics,
 are to be mollified and loosened by the use of emol-
 lents, and then they may be quickly separated or re-
 moved, by which you will have an opportunity of see-
 ing whether the caustic must be re-applied, or whether
 the wound may be deterged by more gentle, abster-
 ge, and digestive medicines.

Desiccatives.] When a wound is moistened with
 too

(e) Galen. Method. medend. Lib. III. cap. 6. Chart. Tom. X. p. 68.

too great a quantity of a thin juice, in that case absorbent medicines, with such as strengthen the vessel will be most serviceable. Such are the absorbent earthy powders, ground or levigated to an alcohol to prevent the asperity of the particles from irritating the wound; those formed of the ashes of burnt bones with gum mastic, olibanum, sarcocol, &c. which corroborate as well as absorb.

By frequently compressing.] Compressure will be chiefly serviceable, when the dilated vessels degenerate into a fungous excrescence or proud flesh, which is not sooner removed by the caustic but it arises again, unless prevented by a moderate compressure upon the parts; of which truth we are convinced by repeated instances of fungosities in the brain, when uncovered. Therefore skilful Surgeons generally dress the wound after incarnation with dry scraped lint, moderately compressed on the face of the wound by a suitable bandage: and sometimes they take a thick pledget spread with some vulnerary balsam, and apply the dry fido to the surface of the wound, and the balsam lying outwards, excludes the air.

S E C T. CCVIII.

THOSE remedies (207) are to be used 'till the wound affords a mild, white, viscid smooth, uniform, and inodorous matter; under which the sordid, tumid, and confused parts are absterged and consumed, those corrupted by the air separated, the cavity filled or incarnated, and the whole agglutinated or united.

All the remedies before enumerated in the preceding aphorism, may restrain the too easy distention of the vessels, and may convert the half-dead parts, as well as the living, into a gangrenous eschar, but they cannot separate the eschar from the living parts underneath: for that is the work of nature only, by suppuration, than which there is no other method of performing

forming it. But the formation of matter is a sign of suppuration, concerning which we spoke in §. 158. numb. 7. When laudable matter therefore appears in a wound, we know that the vessels are in a condition to transmit each their respective juices; and also, that those juices are in a healthy state. We before mentioned what was necessary towards the transmission of the juices in a healthy state to the wound, and therefore we shall here only consider those impediments which reside in the wound itself, and obstruct its incarnation and cure. When we observe laudable matter generated in a wound from the use of proper means, we then know that a separation of the morbid parts, obstructing the cure of the wound, is about to follow. But the matter formed ought to have not only the several qualifications before enumerated, but must also be made equally in every point of a wound: sometimes indeed the whole surface of the wound does not appear foul, but only in some parts, and then the clean parts will afford laudable matter, while the fordid will afford juices of a different kind; whence the matter will not be formed equally in every part of the wound, but differently in different parts; in which case the fordid parts of the wound only will require the remedies mentioned in the foregoing aphorism, and which are improper where the wound is clean.

Under this matter the lacerated and contused parts adhering to the living, with the extremities of the obstructed vessels, and their obstructing matter, are dissected off and separated, whereupon the vessels become pervious, and readily transmit their juices, hence that swelling in the lips of the wound, which arose from the obstruction of the juices in their vessels, begins to disperse and vanish, while those parts also separate which were corrupted either from the contusion or admission of the air, and then the tender pervious vessels elongate, under the mild and laudable matter, with which they are covered and defended as with a natural balsam; so that by meeting and uniting

with those adjacent, they form a new plexus or intertexture of vessels, from whence the lost substance in the wound is regenerated, and the divided parts at length united.

Therefore all that art can do in wounds, is to remove the impediments which obstruct the formation of laudable matter; all the rest being performed by nature, which is always self-sufficient.

S E C T. CCIX.

IN the next place, farcotics, or those remedies which are said to generate flesh, are to be applied, and such are the milder digestives.

These remedies are indeed termed farcotics by the Surgeons; but in reality there is only one real farcotic or generator of flesh, which is nature herself, restoring the lost substance under the laudable matter, as Gale justly remarks in the passage before cited (in §. 151 numb. 9.) *viz.* that the matter of new flesh is good blood; but the author and workman, nature herself. All the balsams and remedies which are said to generate flesh only assist nature, and remove the impediments to that action; nor do they any thing more than restrain the vessels in their due bounds by an adequate compressure, and by disposing them as they ought to be, in a natural and healthy state; and this they do by excluding the air, keeping the parts warm, and confining the extravasated humours, that by standing their due time, they may form laudable matter.

A clean wound is injured by the application of any thing sharper; or more acrid than those now mentioned, since they corrode the tender vessels beginning to be formed, and convert them into matter which must be absterged or removed; and therefore those remedies only are proper here, which are recommended in §. 204. But we know that the cure of

A clean wound advances well, when it appears of a moderate red colour, (for too intense a red denotes an inflammation therein) and beset with a due quantity of audable matter; in the mean time the bottom and sides of the wound fill up or incarn equally without any eminencies above the surface, the lips of the wound at the same time being not distorted or turned back above the surface of the adjacent skin; and lastly, comes an appearance of a pale blue-coloured margin round the circumference of the wound, being the incipient formation of a cicatrix.

S E C T. CCX.

BUT when every thing is done to answer the first intentions in a wound (185 to 188), if there is no loss of substance, the wounded lips are then to be so replaced and retained, that they may unite in their former and natural positions.

The general indications required in the cure of all wounds have been enumerated in §. 185, where the first thing directed was to remove all foreign bodies, or parts of the wounding instrument, or even the corrupt solid or fluid parts of the body itself, which being left in the wound, might impede the union of the divided lips, *per* §. 186, 187, 188, where also the manner and means for their removal, with the necessary cautions, were delivered. If therefore, when all this has been done, there appears to be some loss of substance in the wound, that loss must be first repaired, before the divided parts can be united. The manner in which the lost substance is to be regenerated we have indicated already, from §. 189 to 210. But if the wounding instrument made only a simple division of the parts before united, without any loss of substance, or leaving any foreign bodies behind, there is then only one simple indication, namely, to so apply

the receding lips of the wound to each other, and to retain them so together, that the parts may have the same situation as before their division, *per* §. 158 numb. 1. The re-union of the divided parts thus retained and disposed, is performed by nature only and that in a space of time sufficiently short even in large wounds, under the forementioned circumstances. And in that case, even the best vulnerary balsams interposed betwixt the lips of the wound are prejudicial; for they are foreign bodies which can never unite with, and adhere to, the living parts: all then that is required, is only a mutual application and retention of the divided parts to each other, without the interposition of any remedies.

We are by many observations taught, how easily wounded parts will unite or grow together, not only by the instance of wounds, but also in excoriations and preternatural adhesions. A young nobleman was wounded with a sword, which penetrated not only the left eye-lid, but also the tunica adnata of the same eye and slightly injured the cornea at the same time. By neglect the eye-lid grew to the tunica adnata and cornea; whence the eye-lid could not be opened, but was in continual pain and irritation, because when the sound eye moved, that which was wounded could not avoid moving at the same time; but this troublesome disaster was ingeniously relieved by Hildanus (*a*) Schenklius relates (*b*) from Benivenius, that the parts of generation in a woman grew together from the neglect of her Physician, in the treatment of a venereal ulcer. We have also a proof of the same cohesion in the cutting out of noses, or other parts, from flesh united after scarification, &c. as mentioned §. 183. Celsus also observes (*c*), that fore fingers will frequently adhere together, unless great care be taken to prevent them. If therefore this concretion will

readily

(*a*) Centur. VI. Observ. 7. pag. 503.

(*b*) Observat. Medic. Lib. VI. Observ. 23. pag. 814.

(*c*) A. Corn. Cels. Medic. Lib. V. cap. 28, pag. 332.

readily obtain in parts which never cohered before, much more will it take place, when divided parts, which before cohered naturally, are retained in contact with each other.

S E C T. CCXI.

THE former of these is performed, 1. By placing the parts in that position which they naturally have, when out of action or at rest: 2. By a gentle and equable compressure of the parts towards each other, so that they may rest contiguous to each other in their whole surface.

1. It is highly serviceable for one to be acquainted with the posture which the parts of our bodies acquire when a man is at rest or sleeping; for then all the voluntary motions cease, and the parts of the body being left to themselves, fall into the most natural and easy posture. We then observe, that none of the limbs are extended, but that all of them are a little inflected; so that in a healthy person sleeping, the fingers are never stretched out, nor does the leg make a right line with the thigh, &c. but that all of the joints form obtuse angles. For the muscles bending the limbs are generally found stronger than the extensors, so that when neither of them are in action, the natural contractile power in the fibres of the flexor muscles will overcome that of the extensors, so as to make the limbs always appear in a posture a little inflected, during sleep or rest. What has been said is also very apparent in palsies of the limbs, where all the voluntary actions of the muscles cease: so that when, for example, the whole arm is become paralytic, the fingers are always found and continue inflected, insomuch that it is often impossible to extend them after the palsy is cured; from a rigidity of the connecting ligaments in the joints, and from a contraction

traction of the tendons of the flexor muscles which shrink by their own natural contraction, and for want of being stretched or elongated by the action of the extensors: thus the flexor tendons become shortened so that the extensor muscles cannot overcome their resistance. Even Hippocrates (*a*), who diligently observed the natural habit of the parts, in order to discover how much they varied in disorders, has made the same observation, and in recommending rest to the patient, he says: *Oportet autem ægrotum a medico deprehendi decumbentem in dextrum aut sinistrum latus, & manus & collum & crura parum inflexa habentem, & toto corpore humentem, sic enim plurimi sanorum cubant* “ That the patient ought to be found by the Physician lying down on his right or left side, with his arms, neck, and legs a little inflected, and his body even with the floor, for in that manner lie most people in health.” When this circumstance is neglected in the cure of wounds, the parts grow together in a different manner from what they naturally were in before; and frequently a great deformity arises from the distortion of the parts, or a deprivation of their natural motion. Thus in a child six months old, who had miserably burnt the right hand, the caution being neglected by the ignorant Surgeons, as the fingers grew to the wrist except the thumb, whence followed a great deformity and destruction of the use of the limb; but Hildanus (*b*), by a tedious but artificial treatment, removed this deformity, and restored the parts to their natural motions or uses.

This caution must be regarded at the first dressing of the wounded parts, which being raw or naked speedily unite in their rough posture; so that it will be difficult to correct their position, without a fresh division or wounding of them, when conjoined.

2. We observed before (in §. 158. numb. 1.) that the wounded parts gradually recede from each other

(*a*) In Progest. Charter. Tom. VIII. pag. 600.

(*b*) Centur. 1. Observ. Chirurg. Observ. 83. pag. 60.

by their own contractile power ; but in order to their
 union it is necessary for them to remain in contact ;
 hence it will be also necessary to overcome their
 contractile force by an artificial pressure, to prevent
 their mutual retrocession. But it must be well re-
 marked, that the whole surface of the wounded parts
 ought to remain in close contact ; for if the lips only
 of a deep wound are approximated, and the parts be-
 neath remain asunder, a cavity will then be formed in
 the wound, where the extravasated humours will be
 collected and putrified, so as to convert the wound
 into a sinous ulcer. But this close approximation of
 the parts is affected by the application of compresses
 and a proper bandage, which makes a pressure so as to
 bring the whole surface of the wound into contact, as
 well at bottom as in the skin and lips above. Again,
 it is necessary for this compressure to be moderate, lest
 the vessels in the parts affected should be obstructed
 by too great a force, whence might arise inflammation,
 with all its bad consequences. Lastly, a perfect rest
 of the parts wounded is also required at the same
 time, and therefore the limb should be secured so as to
 remain immoveable ; otherwise the parts may move
 and change their places either in sleep, or by neg-
 lect of the patient, so as to separate and tear open the
 lips of the wound lately conjoined, and frustrate the
 success of the cure.

S E C T. CCXII.

THE divided parts are retained in contact,
 I. By the use of sticking plasters, applied
 on each side of the wound, and indented or cut
 in the shape of fingers, that they may be drawn
 together with a needle and thread ; which is a
 method used chiefly in long and transverse
 wounds of the skin and other loose parts.

Various methods are required to retain the parts in contact, according to the different nature of the wound; being performed either,

1. By what Surgeons call the dry future, to distinguish it from the future made by the needle. They take any kind of sticking plaster that will adhere firmly to the skin, or else the common glue, isinglass or the like, (no matter which, provided it has but due tenacity) and spreading it upon strong lines which will not easily stretch or give way, they apply it on each side at a little distance from the lips of the wound, first gently warmed, to render the adhesion firmer: they in the next place draw the two emplasters, furnished with notches or fingers, towards each other, by passing a needle and thread through them; and thus the emplasters, adhering on each side of the wound, are approximated, 'till the lips come into contact. As the wound itself is not covered by the plaster; one may easily see whether the lips of the wound are united in their natural position and it will not be difficult likewise to rectify them if displaced. The number, figure, and magnitude of these plasters must differ, according to the size of the wound. In small wounds, where the lips do not recede much from each other, sticking plasters cut in the shape of fingers will be sufficient, without threads or strings to tie them together; but in large wounds and in those whose lips recede much from each other it will be safer to apply those plasters which may be drawn close together, by the use of strings passed through the notches or teeth; concerning which plasters and their uses, you may consult (*n*) Heister's Surgery, where they are represented.

But it will easily appear that only the skin is much drawn together by the use of the plasters, and the subjacent fat, especially in deep wounds, being lax and less tractable, does not follow the skin; so that they are only serviceable, where the skin only is wounded.

ounded, and where the parts are so lax as to follow easily after the plaisters. Hence they are chiefly used in wounds of the face and scalp, which are not very deep; as also in superficial wounds of other parts of the body.

After the lips of the wound are conjoined by the sticking plaster, a pledget is applied, spread with some vulnerary balsam, in order to exclude the air; and thus the external face of the wound may be renewed every day, without removing the sticking plaisters, in order to observe if every thing be right.

S E C T. CCXIII.

THEY are also contained in contact, 1. By the application of bolsters or compresses, secured by bandages, so that the gaping lips of the wound (§. 158. numb. 1.) may remain equally pressed together, and unite; which may be easily performed by properly directing the pressure. This method is proper in wounds which are inflicted according to the length of the part.

Not superficial but deep wounds only require this method, in order to bring the parts at the bottom of the wound as much into contact as the lips above, and to render the consolidation equal and compleat. And in the right application of these consists a great part of the Surgeon's skill and dexterity. A bandage applied round a part compresses the whole equally, but by the imposition of compresses the same pressure of the bandage may be made to act more upon one part than the rest, by which means the pressing force may be so directed, as to bring all parts of the wound into contact. But it will easily appear, that this method will be of no use, unless the parts adjacent to the wound are soft and pliable: thus, for example, when a deep wound is inflicted according to the length of the

the

the thigh, the soft parts may be so equally pressed by the application of compresses on each side of the thigh with a restrictive bandage, that the whole surface of the parts divided in the wound may be there rendered contiguous again. But this cannot be so easily effected in parts that are not fleshy; only indeed those parts do not so often receive deep wounds to require this apparatus. Hippocrates seems to point at this method in treating of the various uses of bandages. (a) *Ast ubi quæ expansa sunt, contrahere oportet, in cæteris quidem eodem modo. Ex longinquo tamen quodam intervallo contractio, & sensim progressu facta compressio facienda est, primo quidem minimum, postea magis, maximæ compressionis terminus sit mutuus contractus*: “That as bandage is necessary to contract or remove an expansion or redundancy of parts, so it is also proper, on the other hand, to make an approximation of parts that are very distant, by a gradual compressure, increasing it by a little at a time, ’till the last degree of the compressure terminates in a mutual contact of the parts.”

Though this method is most happily and successfully used in wounds inflicted according to the length of the parts, yet it seems also to be practicable to advantage in some transverse wounds. This is evident from the remarkable case mentioned in the commentary to §. 164, where both the large tendons of the heels, termed Achilles, were broke in sunder by hard dancing, without wounding the skin, insomuch that the ends of the tendons contracted to the distance of three finger’s breadth one from the other: and yet by a proper disposition of the affected parts, with the help of compresses and bandage, the distracted ends of the tendons were reduced into mutual contact, and perfectly united. It is therefore evident, that if this method can be serviceable in so difficult a case, much good may be also expected from it in transverse wounds of the parts.

S E C T

(a) De Medici Officina, Charter. Tom. XII. pag. 68.

S E C T. CCXIV.

THE parts are also retained together, 3. By futures, with steel needles, straight ones for small wounds, and crooked ones for large or deep wounds; which needles should be sharp edged towards the point, and grooved towards the eye, for concealing the waxed thread: they are to be entered at a sufficient distance from the wound, and thrust down to its bottom, from whence they are to rise up through the other lip of the wound, in the same manner, so that by tying the thread, the lips first approximated may be retained together in contact, and afterwards the thread is to be tied in a knot over a soft compress. The same operation is to be repeated from the middle or angle of the wound towards each end, as often as may be necessary. Thus the lips of the wound are to be dressed with some balsam, with soft compresses applied over the knots or stitches, and the whole covered with a plaster.

This method of uniting the divided lips of wounds, is termed the true or bloody future, since the method of uniting them, by sticking plasters, scarce deserves the name of a future. In this operation it is required to make the future with as little pain and irritation to the parts as possible; for when it is performed too roughly, it is frequently followed with a violent inflammation, which impedes the union of the parts in contact. For this purpose it is proper to have needles that are strong, and yet not rigid, to prevent their breaking. Their points are not to be conical, because that figure gradually increasing in thickness, does not pass so easily through the parts; and therefore such are preferred as are of a prismatic shape before,

before, and sharp-edged on the sides, which will easily make way for the rest of the needle to follow, which is either conical or cylindrical. In superficial wounds it may be sufficient to use straight needles of this make; but the deeper wounds will require crooked ones, that being thrust down to the bottom, they may the more easily be raised up and be drawn out. Hence it will be necessary to have needles of various curvatures, agreeable to the different depths of wounds. Unless there be a groove or channel on each side the tail of the needle towards the eye, in which the thread may lodge while the needle is drawn through the parts, the thread sticking out on each side will lacerate the parts and obstruct its course. The thread too is to be first waxed, to lubricate it, and render it easily passable, without imbibing any of the juices which would cause it to swell, and more forcibly compress the parts through which it is drawn; besides which, the humours imbibed by the thread, becoming acrid by the warmth and stagnation, might farther irritate the wound. The needle thus armed with a thread, is to be entered at a sufficient distance from the wound, lest it should afterwards break out and lacerate the parts, as might happen, by fixing the suture too near the margin of the wound. But the needle is to be thrust down to the bottom of the wound, and then carried upwards, so as to ascend through the opposite lip, and come out at a proper distance from the margin of the wound. For if it was not to reach the bottom of the wound, the lower parts would be distant from each other, though the upper parts were brought into close contact, whence a cavity or sinus would be formed, where the extravasated juices stagnating and corrupting, the clean wound would be by that means converted into a fistulous ulcer, to cure which would require a division again of the parts above, which were united by the suture.

After

After the threads have been passed through the lips of the wound, they are to be brought into contact by gentle compressure of the hands, which acting on the skin, the other parts naturally follow (*d*), and then they are to be held in contact by tying the threads. In order to avoid all danger of pain and laceration as much as possible, the knots are to be made upon a piece of linen cerate rolled up, which will not imbibe the humours. More or fewer of these stitches will be required according as the wound is longer, or more or less angular; for as Celsus observes, (*e*) *Si nimis rara est, non continet, si nimis crebra est, vehementer afficit, quia, si saepius acus corpus transivit, quoque plura loca injectionis vinculum mordet, eo majores inflammationes oriri, maxime estate*: "If the stitches are at too great a distance, they will not hold the lips together; but if they are too close or thick, they occasion great uneasiness, because the oftener the needle has passed through the wounded lips, and the more numerous the pinching stitches or ligatures, so much greater will be the inflammation that arises, more especially in hot weather." Lastly, a pledget spread with some vulnerary balsam is applied over the wound, and then all the dressings are secured by a plaster or proper bandage.

If no great pain or inflammation arises, the wound is left thus for two or three days, and then upon removing the bandage or plaster, observation must be made whether the extravasated juices have any fetid smell, and if so, the pledget must be carefully removed, and a fresh one applied in its place, spread with the same balsam; otherwise a few drops of the same balsam may be instilled into the wound without removing the pledget. When the lips of the wound appear sufficiently well united, the threads may be gently drawn out a little with discretion, to see whether they may not be conveniently extracted; as they generally may be without

(*d*) A. Corn. Cels. Lib. V. cap. 26, pag. 293.

(*e*) Ibidem.

without difficulty, and the remaining small wounds quickly healing.

But if the future is followed with great pain, violent inflammation, and tenfity, or tumour of the parts, it will be best to cut them in funder, and compleat the cure of the wound without them; othervise a train of malignant fymptoms would follow, which it would then be too late to remove, by extracting the ftitches, though they might have been timely reftained or prevented thereby.

There are various kinds of futures, and different methods of performing them for the union of wounds, defcribed by the writers on chirurgical operations.

S E C T. CCXV.

THESE futures (214) are proper in fimple, recent, and bleeding wounds, not attended with any great hæmorrhage, nor molefted with foreign bodies, but which are clean, full, tranfverfe, oblique, or angular.

But they (214) are hurtful in wounds, where there is a profufe hæmorrhage, fuch as are old, fanious, purulent, fordid, contufed and hollow, or with lofs of fubftance, and incrufted over; as alfo in very deep and venomous wounds, and fuch as are accompanied with dangerous injuries of the larger veffels, violent inflammation, or which are feated in parts where motion is unavoidable.

This aphorifm determines in what wounds futures may be advantageoufly applied, and in which they will be pernicious.

Recent and bleeding.] For if the wound has been inflicted fome time, and efpecially if it has been expofed freely to the air, the extreme ends of the veffels in the furface of the wound are then become mortified;

fied; and therefore they will require to be separated from the living parts by suppuration, before the lips of the wound can unite; so that here a re-union of the parts would be attempted in vain by future.

[Free from great hæmorrhage.] Because the extravasated blood would distend the lips held together by the future, whence laceration, pain, inflammation, and all their bad consequences.

[Simple.] Such, namely, as have no great contusion. Whence Hippocrates advises, (as we observed before §. 158. numb. 7.) that wounds made by a sharp instrument or dart, are to be cured without suppuration; but if there is also a contusion, then the wound must be so treated, as to hasten the suppuration, because it is necessary to putrify the contused parts, and convert them into matter.

[Full.] That is in wounds which have only a division of the continuity without any loss of substance; or if any part was cut from the wound, the divided parts cannot be rendered contiguous with distorting the lips from their natural situations; whence always follows an ugly scar, and an injury to the action of the parts, from the violent adduction of them.

[Clean.] In which no foreign body or any thing from the wounding instrument remains, and in which there is neither fordes, grumous blood, nor proud flesh; or all these are to be first separated and extracted, before the consolidation can be expected..

[Transverse, oblique, or angular.] Because in such wounds neither sticking plasters, nor the artful application of compresses and bandages prove sufficient to retain the parts together in close contact.

[Hurtful in a profuse hæmorrhage.] When ignorant Surgeons do not regard the particular nature of the wounds they conjoin by future, they often expose the patient to miserable accidents. Of what service will it be to conjoin the parts by future, if they will not unite afterwards; or if the future must be cut open again, to extract the corrupt and extravasated juices retained

tained betwixt the lips of the wound? An instance of this fault we related in §. 172. numb. 3. where an ignorant Surgeon closed by future a wound penetrating into the cavity of the thorax, whereby the wounded patient became in imminent danger of his life, from the repletion of his thorax with the blood, which could not escape through the closed wound. And certainly the miserable patient would have perished, had not Parey cut open the future, and extracted the confined blood from his thorax. Unless therefore the wound be clean and sound in its whole surface, and free from any loss of substance, to make a future of it must always be pernicious. And also, when the wound is inflicted in a part of the body through which large blood-vessels or considerable nerves pass, who but one ignorant of the danger, from not knowing the anatomy of the parts, will be bold enough to thrust a needle deep through them? Nor is the danger less when deep wounds run near tendons or tendinous membranes, which may easily be injured by the needle, and from injuries of which parts the most severe symptoms arise. Add to this, that the lips of deep wounds cannot be retained together by future, so as to bring their whole surface into contact in every point, unless the stitches are drawn very tight together; whence there would be great danger of a laceration, and violent inflammation, with their consequences, in the parts. But if the parts of the wound are already inflamed, it will be so much increased by future, as frequently to produce a gangrene; and besides, it is necessary for the inflamed and obstructed ends of the vessels to be digested off, together with their obstructing matter, by a gentle suppuration, before the surface of the wound can become clean and fit to unite together.

But if the wounding instrument was poisoned, and the virulency thereof excites unusual and dangerous symptoms, the chief of the cure will consist (if we are not acquainted with an antidote to destroy the force

force of the poison) in extracting the extravasated
 juices from the wounded vessels by suction, or by in-
 creasing the influx of juices into the part by cupping,
 wash out and expel the virulency; otherwise the
 part is to be destroyed in a moment by the actual cau-
 tery, to prevent it from spreading the infection thro'
 the rest of the body. It is therefore very evident,
 that a future in wounds of this nature would confine
 the virulency, which according to art ought to be ex-
 pelled with the utmost expedition.

It is also very evident, that an absolute rest of the
 parts conjoined by future is necessary, since if they
 be moved, it will be the same thing as if they were
 continually pulled by a string drawn through them,
 hence a continual irritation, pain, inflammation, and
 the rest of their bad consequences follow. We have
 indeed, in our power to restrain all the voluntary
 motions; but those motions which are absolutely re-
 quired to continue life must always subsist. And
 hence the reason why wounds of the thorax do not ad-
 mit of future, especially those inflicted on its convex-
 surface upon the outside of the ribs; for in such the con-
 joined parts would be drawn asunder with pain at
 every dilatation of the thorax in inspiration. For the
 same reason too, in wounds of the abdomen conjoin-
 ed by future, the whole venter is secured with ban-
 dage, to prevent the contained viscera from pressing
 out of the wound, so that the patient breathes almost
 without moving the abdomen. The ignorance and
 slothfulness of some Surgeons is therefore to be condem-
 ned, who considering wounds like rents in cloth, are
 at sewing them up indiscriminately.

S E C T. CCXVI.

[ASTLY, 4. the parts are retained toge-
 ther, by leaving a needle in the wound,
 passed through both its lips, and with a thread
 Vol. II, R fastened

fastened round each end, so as to retain them in contact, and prevent their separation. This method is proper in large gaping wounds inflicted in pendulous parts.

The future before described, was made by drawing a needle and thread through the wounded lips, which were then drawn and retained together, by tying the thread in knots above the wound; but in the present method the needle is not extracted from the wounded parts, but left in them, and a thread is afterward wound about each end of it, so as to retain the lip in contact, before conjoined and held together by the needle passed through them. This method is chiefly used in the operation for the hair-lip, when that part of the upper lip which forms a small concavity under the nose, is slit in two; for by this means large and gaping wounds in pendulous parts have been happily and uniformly united. But because in the hair-lip the parts were divided from the birth, therefore the callous superficies of them is first removed by a pair of scissars, by which a small wound is also made in the upper angle of the fissure, that the parts to be united may acquire the nature of a recent and naked wound for if any part of the callosity be left behind, in that place there will never be formed a firm union afterwards. When the wounded lips are rightly adapted to each other, the needle is entered at about four line distance from the wound, and passed through the fleshy substance in the middle of the lips, 'till the point of it comes out at about the same distance from the wound on its opposite side: thus the needle being left in the wound, and a thread passed obliquely round each end, so as to make each turn decussate or traverse the other, the parts are by that means retained in contact. A greater or less number of these needles are to be thus fixed in the lips of the wound, according to its magnitude, that the divided parts may be contiguous

ous in every point. But to prevent the points of the needles from doing any injury to the parts, they are to be cut off with a pair of scissars; after which the ends of the needles are to be supported by bits of sponge placed under them, which will better adapt themselves to the shape of the parts than a compress. That the needles may be passed more expeditiously and firmly through the lips of the wound, they are to be first fastened in a handle, since they cannot be so well held by the Surgeon's fingers. And then to avoid giving any injury to the wound, by such a violence as would be required to cut off the ends of steel needles by a pair of scissars, such needles are therefore used which have only steel points, and the remainder silver wire, so that the point with part of the silver is more easily divided, and with a less force; or the same intention may be very well answered, by large steel needles to be guided by the hand, having their back part slit to receive a silver wire, having an obtuse head at each end, and which being introduced by the needle, is left in the wound, and there secured by the circumvolution of threads. For which you may consult Garengéot in his treatise of operations (*a*).

Lastly, when the wounded lips are firmly united, the silver pins are then extracted, and the little wounds they made, and kept open, are then easily cured.

S E C T. CCXVII.

THE last intention in the cure (185 4^o), is obtained by making the parts correspond together as they were before in health, and retaining them so that they be neither too much pressed, nor too loose; avoiding the use of caustics, styptics, or astringents, and having a principal regard to make an equable and gentle compressure over the whole surface of the

R 2

wound;

(a) *Traité des Operations de Chirurgie, &c.* Tom. III. p. 18, &c.

wound; which pressure is again performed by the means described in (186---206), defending the whole with some mild desiccative plaster; and, lastly, by washing the cicatrix with spirituous applications.

The general indications necessary in the cure of wounds, have been before enumerated in §. 185, where they were comprised in four numbers, the three former of which we have been here treating of, and the last that remains to be considered is the method of inducing a cicatrix or skin over the wounded parts, now filled and united, so that it may resemble the natural skin. If the wound was only a simple division of the parts by a very sharp instrument, and they were soon after united again in their natural posture, they will grow together in such a manner, as to leave little or no mark of the wound remaining, which is then healed without a scar. For when a cicatrix or scar is left after the cure of a wound, there is a remarkable difference betwixt the adjacent true skin, and that which is formed in the hiatus or interstice betwixt the lips of the wound, which is then compleatly and artfully cured, when there is no mark left of the wound or division in the parts; but if a cicatrix is unavoidable, care must be taken to make it as nearly resembling the true skin as possible. For when the wounding instrument, or a suppuration following the wound, has occasioned some loss of substance in the parts, in that case there must be a new substance formed, which never altogether resembles that which was lost, but it may be easily distinguished from the adjacent parts.

But the handsomness of a cicatrix depends on the three following circumstances; 1. in uniting the parts in the same position which they had naturally before the wound was inflicted; 2. in restraining the cicatrix from rising above the level surface of the adjacent skin; and lastly, 3. in preventing any cavity in the cicatrix. The first is obtained by a careful conjunction of the
I lips

ps by sticking plaisters, futures, or a retention by
 proper bandage, in the manner they appeared in
 health. The second is performed by a moderate
 pressure on the surface of the wound, sufficient to sup-
 ply the place of the restraining skin; lest the vessels
 deprived of that covering should be too much distend-
 ed by their juices, so as to project above the even sur-
 face of the wound; by neglecting which precaution,
 or by the too frequent application of emollients to the
 wound, the cicatrix is formed with a belt or unsightly
 eminence round it. The third is prevented by duly
 incarning or restoring the lost substance in the wound.
 But hollowness of a cicatrix generally arises from the
 contraction of the adjacent skin pressing the pannicu-
 lus adiposus into and above the wound, where it is de-
 stroyed by suppuration, or else degenerating into
 proud flesh, is removed by escharotics, and is never
 renewed or formed again; whence the cicatrix is de-
 pressed, for want of the soft fat to support or fill it
 up. Hence it is evident, that the concavity of a ci-
 catrix is frequently unavoidable, when the wounding
 instrument, or a violent suppuration has removed or
 destroyed part of the fat. Hippocrates observes, (a)
Ulcerata annua quæcunque fuerint, aut longius tempus habu-
erint, os abscedere & cicatrices cavas fieri necesse est:
 That wounds or ulcers which are of a year's stand-
 ing or longer, corrupt the bone, and necessarily
 leave hollow scars after them." And in another
 place, (b) *Si ergo undecunque os abscesserit, sive ustum sive*
sectum, sive alio quocunque modo, horum ulcerum cica-
trices magis cavæ fiunt: "That when the flesh is any
 how removed from the bone, whether by cutting,
 burning, or any other means, the scars of such
 wounds or ulcers are formed more hollow than in
 others." What unsightly and deep scars are left in
 the skin, after the subjacent panniculus adiposus has

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been

(a) Aphorism. 45. Sect. VI. Charter. Tom. IX. p. 277.

(b) De ulceribus, cap. 4. Charter. Tom. XII. pag. 132.

been destroyed by venereal ulcers, is sufficiently well known.

From hence it is evident, why a Surgeon ought to avoid the use of caustic, styptic, or astringent applications, if he desires a handsome cicatrix; because those remedies either destroy the living vessels, or so contract them, that they will not transmit their fluids, but the dead or obstructed ends of the vessels must be suppurated or removed; whence a loss of substance, a consumption of the fat, and a more or less concavity in the cicatrix follow. It is also hence evident, how much an equable compressure may contribute to the neatness and uniformity of a cicatrix, by preventing the too great distention and protuberance of the vessels.

The signs or appearances of an incipient cicatrix beginning to form itself are these. The margin of the wound or ulcer about to be healed appears more white and compact than before, which whiteness spreads gradually from the whole circumference towards the center; and in the mean time, white specks of the like nature begin to appear in the surface of the wound, which specks spreading equally, and uniting with the margin, form a smooth cicatrix. Thus the wound, which was before clean and moist in every point of its surface, now begins to appear dry where the cicatrix is forming; whence all the remedies which gently dry and corroborate, are termed epulotics, or cicatrifiers; such as lead and its calces formed into emplasters, colophonium, olibanum, sarcocol, &c. which being reduced to a very fine powder, are successfully used for the cicatrification of wounds and ulcers; all which are enumerated in our professor's *Materia Medica*, at the number of this aphorism.

From hence appears the vanity of their pretensions, who boast they can cure all manner of wounds by their secret balsams, without leaving any scar remaining afterwards; when at the same time, the most prudent and skilful Surgeons, know very well that a small and decent cicatrix ouht not to be expected in

wound

ounds that have had a loss of substance or great sup-
uration; and therefore this circumstance should be
retold to the patient, lest the deformity of the cic-
x should be attributed to some neglect in the
urgeon.

Lastly, the formed cicatrix should be frequently
oistened with spirit of rosemary, feverfew, or the
e, which have the property of rendering the parts
animals more firm and compact. For the parts
ely wounded will remain not only weaker, but also
fended with a thinner skin, and so remain more lia-
e to be injured than the skin of the adjacent parts.
ence it is often proper to defend the parts lately
ealed with a saturnine plaster, or with a piece of soft
ather for some time, to prevent any injury from the
trition of the cloths, or the action of the air.

Of HÆMORRHAGE in Wounds.

S E C T. CCXVIII.

F much blood flows from a wound, by the
forementioned causes (159, 160), the flux is
ppressed, 1. by the use of actual cauteries, 2.
y caustics or corrosives, 3. by astringents, 4.
y ligature, or tying up the vessels with a needle
nd thread, 5. by amputating the whole part,
t, lastly, 6. by compressing the vessels with
andage and pyramidal compresses.

Having treated on what is necessary towards the
ure of wounds in general, before we proceed to what
ust be observed in the cure of particular wounds,
ther in the head, thorax, or abdomen, it will be ne-
essary for us to consider some of the symptoms hap-
ening in wounds, which are frequently so violent, as
put the wounded patient in the utmost danger of

his life; so that it is first required of us to remove those symptoms, or at least to abate them, before the cure of the wound can be undertaken. The chief of these symptoms are hæmorrhage, pain, and convulsion.

The word hæmorrhage literally and originally signified a large and swift flux of blood; though it is now taken for any discharge of blood from a part. For *Ἀιμορραγία* seems to be best derived *ἀπὸ τῆς αἵμαλις ῥαγῆναι*, since the word in Hippocrates, as Gale thinks, signifies as much as (*ἀθρόως ὀρμαίν*) to run or flow violently and plentifully: for a slow and moderate flux of blood is by Hippocrates termed *ῥῆρυσιν*, and a slow dropping he calls *σαλαγμόν*. But as Galen observes (*a*) when the term hæmorrhage occurs alone in Hippocrates, without any mention of the part of the body, it must then be understood to signify the bleeding from the nose (*b*).

A large and violent flux of blood in a wound, always denotes that some of the large vessels conveying that fluid are divided, and more especially the arteries; since the veins seldom bleed much, unless very large or compressed by ligature; nor does the blood ever run so swiftly and forcibly from them as from the arteries. If then the flux of blood proves so great that dangerous or fatal events may be thence feared, and if there is no hopes of its stopping spontaneously by the weakened force of the heart, or by the contraction of the artery, recourse must then be had to those assistances afforded by art, for suppressing hæmorrhages: but generally the remedies afforded for this purpose retard the cure of the wound; because the ends of the vessels destroyed by fire, caustic ligatures, compressure, &c. must be first separated before the consolidation of the wound can be obtained.

Various are the methods used to restrain hæmorrhages; but all of them act by contracting the orifice

(a) *Gorræi definit. Medic. pag. 16.*

(b) *Comment. I. in Lib. I. Epidem. Charter. Tom. IX. pag. 1.*

of the dividing vessels, or by congealing the blood, or both together, so as to obstruct its course.

1. The most speedy remedy to stop an hæmorrhage is to touch the end of the bleeding vessel with a red hot iron, which immediately burns up the blood into a thick and irresolvable mass, which stops up the mouth of the divided vessel, while at the same time the vessel itself is also contracted by the force of the fire, by both which means the flux of blood is suppressed. This was a method used for a long time by the Surgeons formerly; so that when they amputated any limb, or performed any operation in which a violent hæmorrhage was expected, they had always actual cauteries in readiness, of various figures and magnitudes, to suppress the flux of blood, by burning the ends of the vessels.

Thus the later Greek and Arabian writers, Paulus Ægineta, Avicenna, &c. suppressed hæmorrhages after the amputation of limbs, &c. with hot irons. Guido de Cauliaco, and others after him, used scalding oil for the same purpose. Vesalius (c) orders the flesh to be divided with a red hot knife, in amputations, that so the hæmorrhage may be suppressed while it is forming. But all these methods have so many inconveniences, that they are at present hardly ever used. For there is no small difficulty in giving the due degree of heat to the iron, which if too hot, generally tears off the eschar which it forms; and if it be not sufficiently heated, the hæmorrhage still continues. Add to this the great pain, violent inflammation, and their several bad consequences, which follow from the use of actual cauteries; and as the whole eschar, or ends of the vessels destroyed by the cautery, must be afterwards cast off by suppuration, and separated from the living parts, there will from thence be great danger of a fresh hæmorrhage upon the separation of the eschar, which will then be more difficult to suppress than it was at first. Therefore as Surgeons
are

are at present acquainted with so much better method of suppressing hæmorrhages, by an artificial compression of the vessels by ligatures, they now hardly ever use cauteries. Even Galen condemns the use of escharotics or cauteries of all kinds, as unsafe in the suppression of hæmorrhages, when he says, (d) *Quantum enim parti in crustam adustum est, tantum profecto ipsi de naturali carne deperditur. Id itaque omne parti decidit dum crusta cadit; atque ob eam rem nuda & sine carne apparet, multisque, postquam crusta decidit, profusio sanguinis, quæ ægre suppressi potuit, supervenit:* “So much of the flesh is destroyed, as is burnt into an eschar; all which will be a loss of substance in the parts when the eschar falls off or separates: and therefore the parts frequently appeared naked and wanting flesh on this account, and sometimes a profuse hæmorrhage has followed the separation of the eschar which it was very difficult to suppress.” For these reasons he advises them to be used only in cases of the last necessity, and especially he directs them in hæmorrhages from a putrid erosion; since by that means the blood is not only restrained, but the spreading putrefaction is also destroyed by the action of the fire.

2. When burning fire is communicated to parts of the body by heated metals or boiling oil, the heated bodies are then termed actual cauteries. But there are some other very acrimonious remedies, which so corrode and burn up the parts to which they are applied, that they form an eschar resembling that produced by actual fire: and these, from the similitude of their effects, are also termed cauteries; but as they do not contain any actual fire, they are therefore termed potential cauteries. They are also termed caustics or corrosives, because they corrode, consume, and destroy the parts they touch. But even the eschar formed by the application of these must be separated and cast off; whence there will be the same danger of a fresh hæmorrhage,

(d) Method. med. Lib. V. cap. 4. Charter. Tom. X. pag. 110.

æmorrhage, as in the use of the actual cauteries : and as all caustics are very acrid, they often irritate and injure the adjacent nervous or tendinous parts to such a degree as produces the most malignant symptoms. The escharotic most recommended for these purposes is the Cyprus vitriol, which scraped into a round ball, or beat into a fine powder, is applied to the ends of the vessels with scraped lint. The blood congeals into a thrombus or grume, almost as soon as it touches the vitriol, which thrombus occludes the end of the divided vessel like a stopper, while at the same time the vitriol constricts the vessel itself, and burns the end of it into an eschar. But then a little ball of vitriol will not continue upon the orifice of a divided vessel, to which it was applied, but by a retention with a proper bandage, as will presently appear.

3. We before spoke of astringents, (in §. 28. numb. 4.) so far as they strengthen the too weak cohesion of the solid fibres in our bodies; but here we consider the use of astringents in suppressing hæmorrhages; and this they do either by contracting the mouths of the divided vessels, by coagulating the effluent blood, so as to occlude their orifices, or by producing both these effects at the same time. There are also other remedies which suppress hæmorrhages, but neither by congealing the blood, nor constricting the vessels, and which from their use are also termed astringents. Such, for example, are the volatile meals of ground corn, calcined alabaster, and the like bibulous substance, which absorb any liquor they touch, and form therewith a hard paste, which occludes the mouths of the divided vessels, and prevents the efflux of their contained blood. But if a large artery is divided; the stream of blood runs so impetuously as to wash away these powders; and therefore but little confidence can be put in them. For the same reason, when these bibulous substances have been applied to wounds after amputations, the Surgeons have been obliged to direct servants to compress the dressings on the

the parts with their hands, both by day and night, whence it is evident, that little can be expected from these substances in violent hæmorrhages, without they are likewise joined with a suitable compressure.

But among the styptics which act by congealing the blood and contracting the vessels, the most recommended is *alcohol vini*, especially when applied hot, for that immediately converts the blood, and even its more fluid serum, into a solid mass, and at the same time powerfully contracts the solid parts; whence it is that the soft parts of animals, preserved in that spirit grow hard and shrink; so that it may be of the greatest efficacy in restraining hæmorrhages, both by acting on the solid, and on the fluid parts. But then the extremity of the divided vessel, contracted and indurated by the application of alcohol, must be afterwards separated, as likewise must the thrombus, or grume of blood which is formed, either by a spontaneous separation, or by the impetus of the blood in the vessel; from whence the hæmorrhage will be liable to return afresh, unless the thrombus formed in the orifice of the divided vessel by the alcohol, be retained there by a suitable compressure or ligature. To which add, that alcohol, being exceeding volatile, is soon exhaled by the heat of the body, so that its action is barely momentaneous, unless more be continually re-applied, and its too sudden evaporation prevented by covering the parts with an oiled bladder. From all which it is evident, that even the use of alcohol, without a suitable compressure at the same time, cannot be safely trusted to in restraining hæmorrhages.

Thus I have seen even a small wounded artery which could not be stopped by the application of alcohol. A Surgeon extracted one of the grinding teeth of a man, which was followed with a copious hæmorrhage from the socket, to stop which the Surgeon applied some powdered vitriol, and even its strong oil, to no purpose: I being called, ordered a little

at dipped in pure and hot alcohol to be applied, or-
 ring the tent to be large enough that it might be
 pressed down hard into the socket upon closing the
 ws; but all was to no purpose, though frequently
 repeated. At last, by filling the socket well with
 y lint, which was compressed tight upon the part
 r three nights and days by the finger of an assistant,
 e hæmorrhage then ceased without returning again;
 at a few days afterwards part of the bony socket,
 hich had its nutritious vessels destroyed by the use of
 e caustics, came away without any other injury.
 nce therefore alcohol would not stop the hæmor-
 age of so small an artery, it is very apparent, that
 will frequently not succeed in divisions of the larger
 teries.

But for oil of turpentine, that will scarce restrain
 bleeding without it be heated. The soft parts of
 imals are, indeed, indurated by lying in oil of tur-
 entine, but that very slowly. But we know that
 s take a much greater degree of heat to make them
 oil than water does; whence heated oil of turpen-
 ne may stop a bleeding by shrinking up, or burning
 e solids, and congealing the blood, since it then acts
 an actual cautery, of which we spoke before. As
 r the very strong fossile acids, such as *spiritus nitri*,
phuris, &c. they are all corrosive, of which we
 eated before. The rest of the mild astringents, as
anguis draconis, *cortices granatorum*, &c. they seem
 have so little efficacy, that one ought not to confide
 them for suppressing hæmorrhages.

From hence appears, what we ought to think of
 e many styptic arcana, which are at present cried up
 y some persons. For small arteries, and even sometimes
 onsiderable ones, naturally close of their own accord
 ter division, especially when the *vis vitæ* is much
 eakened by the hæmorrhage; and many of those
 oasted styptics are sharp corrosives; and others of
 em which are milder, require a ligature or com-
 pression upon the vessel by bandage, whence the hæ-
 morrhage

morrhage is often suppressed rather by the compression of the vessel than by the efficacy of the applied remedy. When M. PETIT, who is a very good judge in these matters, made several experiments with these secret styptics about the end of the last century he found they would sometimes suppress slight hæmorrhages, but they would never answer the promise in amputations of parts (c). Whence it is evident, that we ought not rashly to confide in the boasted arcana.

4. If the divided artery is accessible to the hand so that it may be tied up, the hæmorrhage will then be infallibly suppressed by the constringing ligature. This method of stopping of blood was formerly recommended by Galen (c); for after enumerating the various remedies for suppressing hæmorrhages in wounds, he says, *Quippe de genere obturantium quodammodo est vinculum ipsis vasis sanguinem fundentibus circumpositum, ipsique nostri digiti, dum ea committunt & constringunt*; “ That among the kinds of astringents the “ is one by placing a ligature about the bleeding vessels themselves, which are held by the fingers during the application and tying of the ligature. But he seems to have used this method only in wounds; for in the amputation of sphacelated limbs he does not mention it, that I know of. Also in the amputations of the larger limbs, where the hæmorrhage is so dangerous from the division of large blood-vessels, there is no mention of making ligatures upon the vessels in Celsus (g), who yet says in one place (h), where he describes the treatment of profuse hæmorrhages in wounds, that if other remedies are used without effect, *(venæ, quæ sanguinem fundunt apprehendendæ, circaque id, quod iclum est, duobus locis delegandæ intercidendæque sunt, ut in se ipsæ coeant,*
nihilominus

(c) Acad. des Sciences, l'an. 1735. Mem. pag. 594. (f) Med. Lib. V. cap. 3. Charter. Tom. X. pag. 107, 108, & lib. cap. 5. pag. 111. (g) Lib. VII. cap. ult. pag. 498. (h) Lib. cap. 26. No. 21. pag. 290, 291.

hilominus ora præclusa habeant;) “ the bleeding vessels are to be taken hold of, and a ligature made in two places on them that are wounded, betwixt which they are to be divided, that they may contract within themselves, and by that means close their mouths.” All the Physicians and Surgeons since Galen have suppressed the hæmorrhages after amputations of the limbs with cauteries; and even Vesalius (*i*) himself, in describing the operation, orders division of the flesh to be made down to the bone with a red hot razor, and afterwards to cauterise the large vessels with hot irons. But AMB. PAREY abhorring this cruel method, and observing that many thus created were lost, and that but few escaped after suffering these severe torments, was the first, as he himself testifies (*k*), who tied up the divided vessels after an amputation, protracting them with a pair of piers, and tying them together with the circumjacent flesh by a double thread; but if the hæmorrhage returned by the falling off of the ligature, he fixed a needle through the fleshy parts round the divided vessel, and by tying the thread over a compress that was before applied, he by that means closed the orifice of the divided vessels. Since him, almost every body has rejected the use both of actual and potential cauteries, and adhered to the use of ligatures. They had two methods of making the ligature: for in one they protracted the end of the divided artery with a pair of forceps, and then tied it by passing a thread round; but if they tied the thread too strongly, it would often cut through the artery by degrees, whereby the extremity of the vessel separated too soon, and a fresh hæmorrhage ensued more dangerous than the first, since it was now more difficult to tie the shorter vessel by a new ligature: for which reason Dionis (*l*) advises, after you have made the knot, to pass the needle and thread

(*i*) Chirurg. Magn. Lib. V. cap. 12. pag. 1082. (*k*) Lib. XII. cap. 35. & cap. 33. (*l*) Dionis cours d'Operat. de Chirurg. c. Demonstrat. neuvieme, pag. 509.

thread through the extremity of the vessel and adjacent flesh itself, in order to secure the ligature from falling off too soon; though even this method has been since rejected as too difficult. But if the ligature was applied more loosely to the naked artery, then the blood continually urging against the ligature would gradually thrust it off. Therefore the method used by Parey has been received as the safest, *viz.* to tie part of the adjacent flesh with the artery; by which means the extremity is not only more securely closed but there is also not so much danger of the ligature falling off. It will evidently appear, that ligatures are preferable to the cauterisation of the vessels from the following considerations. When the extremity of a vessel is burnt by the application of an actual or potential cautery, the blood then congeals, and an eschar is formed upon the parts, which like a stopper closes the mouths of the divided vessels: now the thrombus or congealed blood in the end of the wounded vessel adheres to the eschar, so that when the eschar separates, there is only the thrombus left in the vessel to sustain the force of the impelled blood; but the mouth of the vessel being open when the eschar is removed, it will easily yield to the impulse of the blood, and discharge the thrombus, whereupon a fresh hæmorrhage ensues. But when the vessel has been closed by ligature, its end converges; whence the thrombus formed behind the ligature, touches it only in its apex, occluding the vessel with its broader basis; so that when the ligature and extremity of the vessel are digested off, though the vessel be not then absolutely closed, yet the thrombus cannot be discharged by the impulse of the blood, through the narrow or contracted orifice of the artery, by reason of its broad basis; perhaps the smaller parts of the conical thrombus may escape, but its broad basis will be more closely impacted against the sides of the artery, so as to prevent any hæmorrhage. All this

well explained and illustrated, with a figure of the rhombus, by M. PETIT (*m*).

This last method by ligature is therefore much farther than any of the preceding methods, notwithstanding it has its inconveniences: for frequently great pain and inflammation follow from tying the flesh together with the adjacent artery, especially if a divided nerve is also intercepted in the ligature; whence often follows a sudden convulsion of the amputated limb, so as to remove the ligature and renew the hæmorrhage.

5. This method succeeds chiefly when the artery being partially divided, is neither very large, nor too near the heart; for in such a wound the hæmorrhage continues from the retrocession of the divided fibres of the artery by their natural elasticity, whereby the orifice is enlarged and kept open: but if the same artery is totally divided, as we demonstrated in the comment on §. 159, then the two ends of the artery will contract within the adjacent solids; so that by the pressure of the neighbouring parts they will be totally closed, and the hæmorrhage thereby suppressed. When the blood therefore runs in a continued stream from a wound, the divided parts from whence the blood issues ought then to be scarified with a scalpel, in order to make a total division of the injured artery. This method, Galen tells us, he has successfully tried himself (*n*), *Homini cuidam ex vulnere in malleolo facto lacerata fuerat arteria, nec sanguinis effluxus levit, donec Galenus vocatus totam resecurerit*; “in a man who had an artery lacerated by a wound in his ankle, the hæmorrhage from which did not cease, ’till Galen being called, totally divided the artery.” He afterwards adds, that the wound was cured without any aneurism, which is otherwise to be feared in such wounds of the arteries, from the weaker

(*m*) Mem. Acad. des Sciences, l’an. 1731, pag. 123, & seq.

(*n*) De curandi ratione per venæ sectionem, cap. ult. Charter. m. X. pag. 451.

weaker cicatrix being extended or dilated into a sacculus by the blood.

But it is very evident, that an artery cannot be thus entirely divided with safety, unless it is but of moderate size, and not seated very near the heart; for otherwise the hæmorrhage would not cease, though the artery was totally divided, but it would be necessary to tie up or close its mouth by ligature, or some other method.

But we are assured, that a wounded artery, which is not totally divided, may be so secured by a moderate compressure, as to prevent its blood from escaping; for it is not always necessary in such a case to so forcibly compress the artery, as not to admit it having any cavity: such a pressure is barely sufficient as will impede the free efflux of the blood from the wounded artery, and retain the thrombus within the lips of the wound, which thrombus is the chief obstacle to the hæmorrhage; and by growing afterwards to the margin of the divided coats in the vessel, has restored the artery to its former integrity, as was evident in the body of a man killed suddenly, who fortnight before had a wound in a brachial artery which was healed. For it here evidently appeared that the lips or margin of the divided artery did not grow to each other, but the bloody thrombus being inserted betwixt the lips, grew all round to the circumference of the wound (o).

6. A compressure of the divided vessel, is of all the best and most natural method to suppress hæmorrhages, and is what all men naturally use of their own accord; for when they see the blood running from a wound, they compress the wounded parts with their fingers. But this compressure may be applied either perpendicularly to the broad surface of the divided vessel, or it may be applied to the sides of the vessel, so as to bring them together into contact. In the first case the hæmorrhage is, indeed, suppressed for

(o) Mem. Acad. des Sciences, l'an. 1735, pag. 592, & seq.

the present, but the thrombus formed by the congealed blood being of the same diameter with the orifice of the divided vessel, when the compressure is removed or slackened, the thrombus will be easily expelled by the impetus of the blood urging against the back of it; and therefore in making such a perpendicular pressure, it ought to be continued 'till the thrombus coheres or grows to the sides of the vessel, which requires a considerable time; and then such a forcible compressure continued for so long a time, may excite bad symptoms, namely inflammation and all its bad consequences.

But when the compressing force is directed to act on the sides of the divided vessel, they then come into contact, and grow together with a broad surface; and the thrombus of the congealed blood lodged behind the compressed part of the vessel, being nearly cylindrical, cannot easily be expelled through the compressed sides of the vessel, even though they are not as yet concreted, or perfectly united. It is therefore easy to perceive how much this method is preferable to the rest; for if the mouths of the vessels are only closed, the hæmorrhage will be suppressed: but there is no better way of closing or bringing the sides of the vessels into contact, than by this lateral compressure, by which they soon grow together without any separation of dead parts, which must be expected after the application of actual or potential cauteries, and even after the imposition of ligatures. Add to this, that when the sides of the vessels are compressed together by ligature, they only unite in a small surface equal to the compressure of the ligatures; but by lateral pressure their sides are flattened and united on a much larger surface, whence the cohesion will be firmer, and more capable of resisting the impetus of the blood endeavouring to escape. And again, the parts never unite with each other sooner or better, than when they have been lately divided in a recent wound; for then it is barely sufficient to retain the

parts in contact, and nature will perform the rest. The design is therefore most perfectly answered by this method, in which the recent wound is neither molested with caustics nor ligatures, but only a sufficient compressure is made upon the parts where the large vessel is divided.

But to make a happy suppression of the hæmorrhage, and to dispose the wound for healing at the same time, it is required for the pressure to act only on the sides of the divided vessel, and not so much on the rest of the surface of the wound. For this purpose Surgeons use pellets of chewed paper, or scraped lint, which they apply to that part of the wound where the compressure is most required, covering the first pellet with one larger, and the second with another still larger than that, and so on, 'till they have made the dressings sufficiently prominent to act upon the wounded vessel by the circumvolutions of the bandage. By this method is formed a sort of inverted pyramid, whose apex lying upon the sides of the vessel, communicates the pressure received by its base from the bandage, so that it acts only on the parts of the wound where it is required. An accurate description and figure of an instrument for this purpose, is given by M. PETIT (*p*), by the application of which the divided vessel may be safely compressed, and the arterial trunk above the wound at the same time rendered narrower at pleasure, while the wound is dressing; also the compressure of the divided vessel may be increased, or diminished, as there may be occasion by the same instrument. The same gentleman gives a remarkable instance of the efficacy and method of using the instrument, in a nobleman who had his leg amputated above the knee, and the vessels secured by ligature, according to the then prevailing method; every thing succeeded well 'till the twenty-first day after the amputation, when the ligature being removed by the carelessness of the patient, the hæmorrhage

hæmorrhage returned, which was again happily suppressed by the application of a bit of vitriol to the orifice of the bleeding vessel, upon which it was retained by a tight bandage ; but eleven days afterwards the eschar separated, and the hæmorrhage returned afresh. In this dangerous state there seemed to be no other method of preserving the patient, but by compressing the vessel, since the uncertainty of caustics had been already experienced, and the vessel was now so much contracted and shortened, that a ligature could scarce be applied, even with the greatest difficulty. This instrument was therefore used to suppress the hæmorrhage, and with very good success, so that a happy cure was made of so dangerous a wound.

It is therefore evident, that an artificial compressure of the vessels will suppress the most dangerous hæmorrhages, even when other remedies have been used in vain ; and that this compressure will itself suffice in all instances, when the other means can succeed only in some particular cases. But this compressure has the best effect, when it forces the sides of the divided vessel close together at its orifice ; though in some difficult cases a perpendicular pressure against the mouth of the vessel, has happily succeeded in restraining hæmorrhages, as we have a notable instance in the Memoirs of the Royal Academy of Sciences (r). A man who had eight months before suffered a compound fracture of the tibia and fibula, the leg was, by the common advice of the Surgeons, amputated below the knee, but the hæmorrhage could not be suppressed, even by fixing the tourniquet upon the trunk of the artery, nor could a ligature be made upon the divided vessels, since the arteries, which were become ossified, could not be thereby compressed : hence the blood continued to flow in a large and forcible stream ; yet by the application of scraped lint in dossils, with pyramidal compresses, so dangerous an hæmorrhage was suppressed, insomuch that upon removing the dressings

dressings on the fourth day after the operation, there was not a drop of blood lost. It also sometimes happens in amputating the leg, that the artery (which penetrates the tibia in its upper and back part, and which often runs the length of a finger within the substance of the bone) being divided, perpetually bleeds, as being lodged in a bony canal, in which it is divided by the saw. It is very evident, that in this case ligatures will have no effect, and that the doubtful malady can only be removed by the application of scraped lint, forcibly compressed upon the orifice of the divided vessel (s).

S E C T. CCXIX.

R Evulsion is here (218) of no use, unless the wounded vessels (159) are small, and the patient be plethoric; nor can relief be here expected from drinks, diet, and internal medicines. What has been here said of hæmorrhages, is also true of sharp, lymphatic, or serous discharges; though in these last much good may be done by the thicker balsams.

[Revulsion is here useless.] Galen (t), in giving us the method of suppressing hæmorrhages in wounds, says, that it may be performed, *obturato quidem, quoque interruptum est, averso autem atque aliorum translato, quod per illud ferebatur*: “by closing the divided vessel, or, by diverting and translating the fluid running through it.” But as he was ignorant of the blood’s circulation, with which we are at this day acquainted, we need the less wonder that he should think revulsions of great service in suppressing the hæmorrhages of wounds. But if a large artery is divided, what relief will the patient receive from opening

(s) Mem. Acad. des Sciences, l’an. 1732, p. 536.

(t) Method. Med. Lib. V. cap. 3. Charter. Tom. X. pag. 136.

ing a vein in any part of the body? certainly the blood will continue to run from the open wound of the artery, where there is no resistance, 'till the patient either faints or dies. I have even seen repeated phlebotomy of no use in an hæmorrhage following the evulsion of a tooth; and what service then can it be of, if a larger artery is divided, when it could not suppress the flux of blood coming from so small an artery? Nor can any relief be expected from other revulsions, made by frictions or irritations of the other parts remote from the wound; for such will rather be pernicious, because they will increase the blood's motion first in the part, and then throughout the whole body.

But where there is a plethora, or much blood, and its quantity is not sufficiently diminished by the hæmorrhage, the wounded vessels being small, in that case the opening of a vein may be serviceable, by diminishing the quantity and impetus of the blood, so that the wounded vessels being less distended, may contract themselves more.

Nor from drinks, diet, or internal medicines.] When the hæmorrhage is suppressed by the remedies prescribed in the foregoing aphorism (§. 218), such meats and drinks are to be carefully avoided, which too suddenly increase the quantity and motion of the blood, before the wounded vessel is well consolidated; and in that respect a proper regimen in diet may be of great service. But then it is very evident, that this can be no obstacle to a profuse hæmorrhage from a large blood-vessel divided, which requires to be immediately restrained: or even if we allow that the aliments may have some effect that way, the time required for the chyle to be thence formed and transmitted to the wound would be so long, that the patient must be lost in the interval. The same is also true of such internal medicines, which have an efficacy ascribed to them of suppressing a flux of blood from a wound. For it is evident from what has been

before said, that the most powerful astringents cannot suppress an hæmorrhage so securely, that they may be safely depended on, even though they are applied in ever so large a quantity to the wound. What then can we expect from things taken internally, which mix with the whole mass of blood, are changed by the actions of the cylicative, and sanguificative organs, and are at last brought in a very small quantity to the wounded part, where they will escape with the juices through the divided vessels? But we know that all remedies which can suppress hæmorrhages, do either by contracting the vessels, or by coagulating the blood which is about to escape, or by producing both those effects conjunctly at the same time. If then such medicines mix with the blood, and act in that manner upon the vessels through which they flow, will they not rather destroy the patient by first constringing the small vessels of the lungs, or by coagulating the blood, so that it cannot circulate through the lungs, before they arrive at the wounded parts? When small arteries are divided, they contract by their own elasticity, and close themselves, as we observed in §. 159, and then the suppression of the hæmorrhage is frequently attributed to these internal styptics when it arises from very different causes. There are many of these styptics publicly applauded, some of which may be safely taken, since they neither do good nor harm; but no prudent person will confide in them, for if more powerful helps are neglected in the mean time, the patient will be exposed to the utmost danger.

The same is true of sharp serous discharges, &c. Slight wounds are sometimes attended with a copious discharge of a thin lymph, from an injury of the larger arterial lymphatic vessels; for the lymphatic veins wounded, scarcely seem able to pour out so much lymph, like as sanguiferous veins wounded, discharge very little blood, unless they are large, or obstructed by ligature, or other means, betwixt the

wound and the heart. But that serous or ichorous discharge which comes from a wound in the lymphatics, ought to be distinguished from that which follows after a puncture in a nerve or tendon, in which last it is accompanied with a very severe inflammation, and requires a very different treatment, as we observed in §. 163. But we are here considering only that flux which come from injuries of the vessels, and such may be easily suppressed by the same means as hæmorrhages. It was affirmed in the preceding paragraphs, that an artificial compressure of the vessels was the most safe and effectual method to suppress hæmorrhages, even profuse ones; and the same means appears capable of restraining this serous discharge.

A Surgeon having opened a venereal bubo with a lancet, before it was come to maturation, he at the same time unhappily divided a lymphatic vessel, whence a large quantity of lymph was daily discharged from the wound. Upon consulting the celebrated Ruysch (a), he soon discovered the cause, and by applying compressures made of dossils of lint, forcibly compressed on the part by a button or truss, he so happily removed the disorder, that the next day the whole serous discharge was suppressed. But if such a compressure was made to restrain the discharge following the puncture of a nerve, it would in a short time cause the inflamed parts to degenerate into a gangrene. All the natural balsams, and especially those of the thicker kind which abound in a thick oil, are here very serviceable, and may close the wounds of such parts; they are found to be inoffensive and healing to the injured parts, and are only useful in punctures of the nerves and tendons. When these are applied hot to the wounded parts, which is the common practice, they may also then in some measure contract and close the mouths of these small vessels by their great heat.

Of

(a) Ruysch. Observat. Anatom. Chirurg. Centur. Obser. 41.

Of PAIN.

S E C T. CCXX.

THE sense of pain arises when a nervous filament, coming from the brain, is so extended, or otherwise disposed, as to be in danger of breaking.

Pain is such an uneasy sensation in the mind, as being detested by human nature, she excites all her powers to remove the cause of such a displeasing perception. For a sound man has in himself the faculty of perceiving certain ideas from certain changes or impressions made on the nerves, which he cannot any ways avoid. Thus, if a hot iron touch any part of the body of a Philosopher, who is in a manner lost in deep meditation, his thoughts will suddenly be changed, and that displeasing idea, which we call pain, will arise in his mind. But what that perception is in the mind, cannot possibly be explained by words; and he only knows it, who himself suffers pain. For no representation of any thing different from thought arises here, but it is an affection of that itself which perceives; for no one in pain thinks there is something similar to it, which exists without him, but every one says, I am myself in pain.

The idea of pain does not leave any impression of itself upon the memory, for one who has been in pain, and is freed from it the next moment, remembers that he was in pain, but cannot revive that idea of pain which he then had, nor can the mind be any way made sensible of that pain, without a fresh cause shall first so change the body, as to cause a change in the thoughts of the mind.

But what that change is in the body, and in what parts of the body it is made, to excite the idea of pain in the mind, we are capable of knowing by experience

erience. For it is demonstrated, that the nerves only, arising from the brain, have the faculty, or power of being so affected, as to excite the idea of pain in the mind; since if a nerve, which is the only one distributed to a part of the body, be cut or destroyed, that part of the body may be wounded, burnt, &c. without exciting any idea of pain in the mind, though all the other component parts thereof remain sound, or entire. But all the nerves of the whole body arise either from the medulla oblongata, which is itself composed of the medulla of the brain and cerebellum; or else from the medulla spinalis, which is a continuation of the medulla oblongata, with the addition of the medullary fibres from its own cineritious substance. And that the nerves only which arise from the medullary substance of the brain, are capable of exciting the idea of pain in the mind, is evident, inasmuch in all diseases which destroy the action of the brain through the nerves, there is no pain perceived. Thus those who fall down dead drunk, or perfectly apoplectic, from an effusion of the humours in the cranium, have no sense of pain, even though the parts of their bodies are burnt with actual fire: and the like we frequently observe, by sad experience, in deep epilepsies: whence it is evident, that the nerves only arising from the brain, have the faculty of exciting the idea of pain in the mind, from such a change made in them. But then, what is this change in the nerves arising from the brain, which excites the idea of pain in the mind? It seems to be such a disposition of it, as by increasing, or long continuing, will divide the continuity of the nerve. For if the smallest needle be thrust under the finger, or toe-nail, in a man who is perfectly well, without the least pain, or any other defect in the solid and fluid parts of his body, it has no sooner entered but there immediately arises an intense pain, which will cause the whole man to tremble, or become affected, only from so slight a mechanical change made in the nervous papillæ. Nor does

does it matter by what cause, or in what manner the nerve is affected, provided only that it be so disposed as to be nearly suffering a solution of its continuity without absolutely breaking (for the nerve being divided, or destroyed, the pain then ceases), for it will then certainly excite that ungrateful idea in the mind which every one calls pain.

But that this change in the condition of the nerve may excite the idea of pain in the mind, it is necessary for a free action or communication to subsist from the nerve to the brain, and from the brain to the nerve; for if a ligature be made on the nerve in its progress the mind will not be sensible of pain, even though you pull, lacerate, or otherwise injure the nerve. The mind will be likewise equally insensible of pain, when the function of the brain itself is injured, without an alteration in the nerve through its whole course. It is therefore evident, that the change made in the nerve causes some change in the brain itself; and that the change thus made in the brain excites the idea of pain in the mind. Hence, therefore, it seems probable, that the idea of pain may sometimes arise in the mind without any action or change in the nerve, provided the brain itself be from any cause so affected, as it was from the approaching rupture or destruction of the nerve in any part of the body. This is confirmed by practical observation: for it frequently happens that those who have lost limbs by the calamities of war or other accidents, will complain of a pain in their absent toes; and in some it has been observed, that such a sense of pain was the sign of a consequent convulsion, arising from the change it made in the brain which is the source of all the nerves (*a*). Nor did this happen only soon after the amputation, but even for a considerable while after. Since therefore the common sensorium, or spring of sense and motion in the brain, from whence all the nerves arise, is more easily affected

(*a*) Miscellan. curiosor. decur. 1 Ann. 2. pag. 32. Hildan. Observ. Chirurgical. Centur. III. Observ. XV.

affected in some people than in others, they will be subject to many disorders and pains which they ascribe to external causes, and which in reality proceed only from their *sensorium commune* being too easily moved or irritated.

Hence Sydenham perceiving that bleeding, purging, &c. were of no service in those diseases which arise from a disturbed motion of the spirits, concludes at last (b), *Quod uti homo quidam exterior conspicitur, ex partibus sensui obviis compaginatus, ita proculdubio & interior est quidam homo, è debita spirituum serie & quasi fabrica constans, sub rationis lumine contemplandus. Hic però cum temperie corporis intimius conjunctus & quasi unitus, tanto ægrius faciliusve de statu suo dejicitur, quanto major est minorve ea, quam à natura sortimur, principiorum constituentium firmitas*: “ That as the external man appears made up of parts obvious to sense, so doubtless there is a certain internal man to be considered in the eye of reason, as made up of a series of spirits duly disposed, or put together. But as this last is most intimately conjoined, and as it were united to the habit of the body, it is more easily, or difficultly disordered, as our constituent principles received from nature, are more or less firm.” Hence in such disorders as have pains invading various parts, and resembling different maladies, he justly accuses only the irregular or inordinate motions of the animal spirits, and only directs his endeavours to qualify them; having well learned from experience, that then all those pains will be eased, and those symptoms removed, which by their surprising variety imitated different diseases. What confirmed this to him, was, that passions of the mind could produce a myriad of disorders in such tender bodies, even though they ailed nothing the minute before.

If we therefore suppose all the sensible parts of the body to remain, while all the insensible ones are removed,

(b) Sydenham, Dissert. Epistolar. pag. 496.

moved, we shall have an idea of Sydenham's interman. But in this case, how much would be removed from the body? The whole heart, which is so much agitated, inflamed, &c. in acute diseases, does not ache, but is only sensible of a troublesome anxiety; the whole lungs are often entirely consumed and turned into matter, without giving any pain; and even so are the kidneys; but yet the pelvis, and internal membranes of the ureters, belonging to these last, are never affected without exciting severe pains; the whole liver is often consumed by an abscess without pain, but when its external membrane is affected, it gives the most intense pain, &c.

The idea of pain therefore arises in the mind from such a disposition of a nervous fibre as endangers its continuity, or threatens a rupture; but this so, that it seems very probable the idea of pain may arise in the mind from a like change in that part of the brain itself, whence the nerves arise, without any impression made upon the nerve. And this holds true not only in the nerves, which being dispersed throughout the body, are a guard to give intelligence by exciting pain, that a person may avoid, or remove every thing which acts destructive and injurious to the parts; but we also observe the same in other nerves, whose office is to excite distinct ideas from pain in the mind, in which ideas arise as distinct and vivid, without any action of an external object upon the sensitive organ, but merely from a change, or impression, on the common sensorium in diseases. Thus phrenitic or delirious patients often see surprising phantasms, and hear strange noises, &c. though there was no external cause to make impressions on the nerves to excite those ideas in the mind. Thus it is too in those who are either melancholy, or raving mad.

S E C T. CCXXI.

WHICH pain is the sharper, as the fibre is nearer to a rupture ; and the milder as the nerve approaches nearer to its natural tension.

Since it is evident from our preceding definition of pain, that the idea of it is formed from such a disposition of a nervous fibre, as threatens its dissolution ; it naturally follows that the pain will be severe, as the exciting cause more distracts the nerve without breaking its cohesion ; for when that is done the pain ceases. And, on the contrary, that the pain will be less severe, as the nerve suffers a less distention. This is evident from the tortures inflicted by the judges on criminals, to extort a confession against their will. For when the man is hung up by his hands, weights are hung to his feet, which being gradually increased, so as by degrees to augment the distraction of the parts, the pain becomes more and more severe, 'till it arrives at its greatest pitch ; and when the weights are taken off, the pain then lessens proportionably. There are many nerves in us which are very lax, so that they may suffer a considerable distention without pain ; but when they are originally extended in the parts, as in the periosteum stretched over the bones, then the least addition to their tensity excites the most excruciating pains : and hence those severe pains in the venereal disease, when the tumefying bones distend and lacerate their investing periosteum. And hence that most sharp kind of torment, which the executioner inflicts by applying a screw against the periosteum of the tibia, so that by gradually pressing that very sensible membrane against the spine of the hard bone, they give the most acute pain. For these reasons the most acute pains arise in the smallest nerves ; since the larger nerves have but a small part which can be properly termed the substance of the nerve : so that such a large
nerve

nerve may support a considerable distention by its hard integuments, without any distraction of its smallest nervous fibrils. But when a very small nerve is stretched, and especially one which is not defended with those hard integuments, then the slightest cause may give the most severe pain : the truth of which we are taught in the tooth-ach, where the vitreous crust of the tooth being eat away, the small nerves disperse through the internal substance of the tooth, undefended by their integuments, are so severely tortured only by the contact of the air, exciting so intolerable pain, that it cannot be removed but by destroying the nerve by caustic medicines, or by an evulsion of the tooth.

S E C T. CCXXII.

HENCE, the most acute pain can last but for a short time, in the same part ; but a pain less intense may continue longer, and may be increased or diminished at times.

Since pain supposes that condition of the nerve in which it approaches to a rupture, or in which a solution of its continuity is threatened ; it is evident, the acutest pain will arise, when the nervous fibres are actually breaking ; but a nervous fibre being broke, all the pain arising from the too great distention of that fibre then ceases. The most acute pain therefore, denoting a speedy rupture of the nervous fibre, will be short, because the fibre being broke, it no longer continues. Thus when a wound is inflicted by a very sharp razor, a momentaneous pain is perceived, which instantly vanishes ; and in the gout, the height of the fit is observed to be the sooner over, as the pains are more severe. When the small nerves are laid bare in a carious tooth, by sucking such a tooth they are so distracted, that the pain thence arising is scarce to be tolerable.

able for a few minutes, even by the stoutest man; at those nervous fibrils being ruptured or destroyed, the pain ceases in a little time. While the tooth is extracting, the pain is the highest possible; but when it is drawn out, the pain instantly ceases. The most intense pain therefore quickly destroys the aching nerve, and so affects the brain, that it remains no longer capable of perceiving pain, the patient in that case generally falling into a swoon, or an abolition of the vital and animal motions. Nor can the severest pain in the world proceed any farther in its effect than this; for then the patient is like a dead body, no longer sensible; of which we have many instances, when malefactors condemned to torture become lifeless in a manner all of a sudden, after which they are no longer sensible, even of the most excruciating torments.

But some may think it repugnant to this opinion, that so severe a pain as the tooth-ach often is, should continue for so many days, or even weeks together, torturing the patient: but the reason is, that the nerve entering the tooth, distributes itself into many smaller nervous fibrils, which are dispersed through every part of that bone; so that tho' one fibril is destroyed by the severest pain, yet the destructive cause proceeding to act upon the remaining fibrils successively, will continue the excruciating pain for a long time.

But since a more remiss pain supposes a lesser tension of the aching nerve, it will therefore be in less danger of a rupture; whence it evidently follows, that such a pain may continue much longer than one more severe: and as an infinite number of degrees may be conceived betwixt the natural tension of the nerve, and the highest distraction of it, when near a rupture; it is evident, that such pains may not only continue for a long time, but also be more or less acute, according to the greater or less degree of distraction of the nerve. But those pains which arise in parts near the heart, and are accompanied with an intense fever,

do not last long from their destroying the aching parts; but those pains which are seated in parts very remote from the heart, and are without much fever or inflammation, these continue a long time and frequently return, because they are tolerable without destruction of the aching parts. The horrid inflammatory pain of the Iliac passion, often kills even the strongest man in a few hours time. The gout in the feet, on the other hand, may return frequently for twenty years running, before it destroys the aching parts, and converts them into a calx, and when it has done that, the pains go off or abate: but when the gouty matter which lay acting in the extremities is carried to the internal viscera, it is often of the most fatal consequence.

S E C T. CCXXIII.

THE cause of pain therefore, is every thing which produces the extension or disposition in the nerves before-mentioned (220).

By the cause of pain therefore in general, is understood every thing of what nature soever, which distracts, or otherwise affects the sound nerve, as to endanger a rupture of its continuity: nor does it signify whether this be done by pressing, distracting, eroding, &c. since the effect will be always the same, viz. the idea of pain formed in the mind. But the idea of pain arising from different causes, may differ in degree and duration, though it be productive of the same effect.

From hence it is evident, how many different causes may excite pain in a healthy body. But in order that the Physician may be able to detect the latent cause of pain, and to remove it when discovered, the several causes which have been hitherto observed, as productive of pain, ought to be reduced to their certain classes, as may be seen in the following paragraph.

S E C T. CCXXIV.

TO which (223) is referred,

1. The natural elastic or contractile power of the solids, sustained but by a few pores, while the rest are divided (183).

2. Every thing which occasions a vessel, composed of nervous fibres, to be over filled or distended; as obstruction, plethora, a redundant cochymy, and an increased motion of the circulating juices.

3. Every thing which violently stretches or distends the parts, whether by dislocation, tumour, or internal force.

4. Every thing which wounds or corrodes the fibres,

1. This has been already considered in §. 163. and

2. This is very evident in the worst kind of paronychia, where the flexor tendon of the finger is invaded by the most excruciating pain; for in this disorder the last bone of the finger very often comes away, after the patient has suffered the most tormenting pains in it. But the bone cannot be thus lost, unless the tendon to which it was connected be first divided or separated, which is not done at once, but by a slow distraction. There is no part of the body furnished with such strong muscles in proportion to their size, as the fingers; and the muscles being contracted in the paronychia, the fingers always appear flexed. When therefore the tendon begins to separate from the bone, the rest of the entire fibres then sustain the whole force of the contracted muscle, and are therefore distracted from the bone to which they adhered, by a continual and slow laceration; from whence frequently arises so severe a pain, and so great

a disturbance in the brain, that a phrensy, convulsions, and even death itself sometimes follows: in short, the torments arising from a gradual laceration of the bones from their connecting soft parts, are so great, that they quite surpass all human patience. *Philotas, quanquam hinc ignis, illinc verbera, jam non ad quæstionem, sed ad pœnam ingerebantur, non voce modo sed etiam gemitus habuit in potestate; sed postquam intumescens corpus ulceribus, flagellorum ictus nudis ossibus incussos ferre non potuit, si tormentis adhibitori modum essent, dicturum se, quæ scire expeteret, pollicetur* &c. “ Thus Philotas, though tortured both with fire and stripes, would neither answer, speak, nor cry; but when his body swelled with ulcers, he could not bear the strokes of the scourge upon his naked bones, but promised he would declare what was demanded to be known (a), &c.”

2. It has been demonstrated in the comment §. 39. that the larger vessels consist of membranes convoluted, in which are contained all sorts of vessels, even the minutest in the body, viz. the smallest nerves: every thing therefore which over-distends the sides of the larger vessels will also distract the nerves spent in them, from which distraction the idea of pain will arise in the mind, as we observed before. But it may be doubted, whether all the vessels in the body have sensible nerves in their membranes, since as we observed in §. 22c. there are many viscera which from anatomy appear to be congeries of vessels and which are notwithstanding suppurated or consumed with little or no pain. So that this assertion seems to be true only in those vessels, whose constituent membranes receive nerves from the brain dispersed through their substance for sensation. But that the sensation obtains in many vessels is evident, since the slenderest needle cannot be entered into the skin any part of the body without wounding the vessels and extravasating part of their contained juices, a
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(a) Q. Curtii, Lib. VI. cap. 11.

ended at the same time with a very sensible pain. But the causes, which distend the vessels furnished with sensible and nervous fibres, are chiefly the following.

Obstruction.] This always supposes a stoppage in the canal through which the vital juices ought to have free passage, whence it necessarily follows, that the fluid impelled to the obstructed part of the vessel being unable to go forwards will dilate the sides of the vessel, render them thinner, and at last break through them, as we demonstrated in the comment to §. 120; it is therefore evident, that the nervous fibres constituting the sides of the obstructed vessel being very much distended, and at last ruptured, may excite pain, and that in various degrees of intensity, according to the degree of distention. When the arteries about the ribs are obstructed with impervious blood in a pleurisy, being distended by the vital juices urged on behind the obstruction, what an intense pain does it produce, which is always the severer, as the blood is impelled into the obstructed vessels with a greater impetus; whence the *vis vitæ* being weakened by phlebotomy, the pain either diminishes or wholly ceases. Hence the obstruction is not properly the cause of the pain, but the impulse of the juices dilating the vessel behind the obstruction so as to excite pain.

Plethora.] It was proved in §. 106. numb. 8. that too great a quantity of good blood might over-distend the vessels and even break them; whence all the degrees of pain, which may follow from a præternatural tension of the vessels 'till they burst, may arise from this cause only. This is evident from the troublesome head-achs, which so frequently result from a mere plenitude, and which are generally so well relieved by bleeding: women also have frequently pain, in various parts of their bodies from the same cause, before their too great plenitude is discharged by the menstrual flux, and which pains vanish when the re-

dundant blood is lessened by the opening of the dilated vessels in the uterus.

Redundant cacochymy.] This name comprehends every morbid condition of our juices, in which they degenerate from their natural and healthy state. To great a distention of the vessels may therefore arise as well from morbid juices accumulated, as from redundancy of good blood; hence pain is excited from a distraction of the nervous fibres in the membranes composing the vessels. We do not here speak of the too great acrimony of the juices, which they may acquire by degenerating, so as to corrode and irritate the sensible fibres, and thereby excite pain. When an unactive watry defluxion settles in the panniculus adiposus, and when the skin is distended from the incumbent water in an anasarca of the legs, pain then arises from that cause only.

An increased motion of the circulating juices.] was demonstrated in §. 100. that a bare increase of the blood's motion through the vessels, by augmenting the heat, would also increase the rarefaction of the juices, whence must follow a greater distention of the vessels; and from the ingress of the grosser fluid into the small dilated vessels must arise obstruction, pain, inflammation, &c. But all these cannot be produced without a distraction and laceration of the nervous fibres dispersed through the membranes of the vessels, whence it is evident, that pain must thence arise. Pains of the head and limbs may arise in fevers barely from the increased motion of the juices; and when the fever is removed those pains vanish.

3, Every thing which forcibly distracts the fibres of our body diminishes their cohesion, and such a distraction may therefore produce a solution of the continuity, if it either increases or continues to act; but it is evident from the definition of pain §. 22 that such a condition of a nerve, as threatens a dissolution of its continuity, will excite that displeasure

idea in the mind. And therefore a distraction of parts, furnished with nervous fibres, may excite pain from whatever cause that distraction may arise. Hence, when luxated bones, being displaced from their natural and containing cavities, distend the connecting ligaments of the articulations, the most severe pains arise, which immediately cease when the bones are replaced, unless the ligaments or some of the adjacent parts, being distracted or compressed by the luxation, are already inflamed: which is a manifest token, that the pain arising after the luxation proceeded only from the distraction of the ligaments. Hence Hippocrates advises, that in those who have had a luxation of the humerus reduced without any pain remaining, and without any inflammation in the adjacent parts, nothing more is there necessary, than to be very careful to prevent the replaced bone from slipping out again from its articulation; and therefore he directs the Physician to preface this danger, since a luxation more easily returns in such a case than when the ligaments are inflamed (*b*).

It is now very obvious, that pain will be likewise the consequence of a distraction in the parts from tumours arising from various causes. Thus the nerves dispersed through the ligaments of the articulations, being distracted in the inflammatory gout, spina ventrosa, exostoses, &c. excite the most excruciating pains. And how severe a pain may arise from an external distention only, may appear from the tortures of maffactors, where the limbs are extended either by weights appended, or by pullies.

4. Every wound, as appears from its definition §. 145. is a solution of continuity in the soft parts; but while the wounding instrument divides the parts continuous to each other, it puts the nerve in that condition which threatens its dissolution, and therefore pain will be the consequence; but such as instantly vanishes if the wounding instrument makes a

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swift

(*b*) Hippoc. de Articulis textu 29. Charter. Tom. XII. p. 308.

swift division of the parts; however, pain continues while the wound is inflicting. But that pain, which arises in the wound some time after it has been inflicted, results from the distraction of the fibres by a contraction or separation of the wounded lips from each other: hence there is, indeed, a pain following the wound inflicted, but such as does not result from the wound itself as the immediate cause, but from a change made in the wound by a contraction of the divided parts. For a nerve near upon breaking excites the idea of pain, but when divided the pain ceases so that there is pain while the wound is inflicting but when the wound is made the pain vanishes.

But all things which corrode, being applied to and put into action by the heat of the living body (for in a dead body their action is little or nothing, except fire), lacerate and destroy the sensible parts by making an infinite number of little wounds; from whence arises a pain both intense and lasting.

S E C T. CCXXV.

FR O M hence we discover the many different causes (224) of pain (220) in a wound (145).

If all that has been hitherto said be applied to a wound, it is evident there may be a great number and variety of causes exciting pain in wounds. For the wounding instrument is first the cause of pain in the moment it inflicts the wound; and then part of the instrument left in the wound may be another cause of pain: the lips of the wound receding mutually from each other, the laceration of nerves half divided, and the distraction of small nerves from the contraction of larger nerves wholly divided, may each excite the most intense pains. While on the other hand, the inflammation, tumour, and distortion of the lips of the wound, with the fever increasing the velocity

velocity of the fluids, prove new causes of pain. When the extravasated juices in the cavity of the wound corrupt and degenerate into an acrid state, they will again erode and irritate the parts so as to excite pain, which will also arise from the application of acrid substances, of all denominations. When the head and obstructed ends of the vessels are separated from the living by digestion or suppuration, a fresh pain arises, which again ceases when the suppuration is completed. All these are to be carefully distinguished, that by knowing the real causes of pain in the wound, the proper remedies may be applied.

S E C T. CCXXVI.

AND the effects of pain are also from thence (225) intelligible; such as restlessness, tossings, watchings, fever, heat, thirst, convulsions, and gangrene.

When pain is present in the body, it is followed with certain effects, the chief of which are these following.

Restlessness and tossings.] When we perceive objects or ideas, a certain change arises in our mind, which is either agreeable or displeasing; or, which sometimes affords neither pleasure nor displeasure: as when I perceive a circle divided diametrically is cut in two, this neither pleases nor displeases me. But when cold hands are brought near a moderate fire, every body says this pleases them; on the contrary, if the fire touches the hands, every one says it displeases them. In what manner the mind is pleased or displeased, is perhaps not explicable; but every one finds the fact true in himself. Now this pleasing or displeasing impression, which accompanies the perceived idea, produces certain effects in us, which the highest reason cannot suppress or hinder, notwithstanding

standing what some proud Philosophers may boast. For the will endeavours with all its power to retain what is pleasing, and to dispel the disagreeable impression from the mind; and then follows certain corporeal actions, not determined by the prescience of the mind, but such as he termed merely automatic or spontaneous from the mechanism of our bodies by which actions we endeavour to avoid or remove the objects which excite the displeasing sensation in the mind. This is our frail humanity which we cannot avoid. When a Philosopher is almost lost in deep meditation, if his finger be but suddenly pricked with a needle, he will that moment pull away his hand without any consciousness or volition previous to the motion. Whence the sense of pain seems to be a faithful safeguard to admonish us to avoid everything destructive to the body. And hence we see that men in pain will continually agitate and vary the posture of their bodies, 'till they acquire that position in which the sense of pain is either avoided or lessened: and hence that inquietude and tossings of the body when in great pain. But when the least motion increases the pain, then the patient is still an immoveable, as we see in the severest fits of the gout and in the most painful rheumatism.

[Watchings] When a healthy person is asleep and all the senses still, he may be awakened by any thing that much affects the sensitive organs; and much more will sleep be impeded, before it comes on, by the presence of pain which so strongly affects the brain. And therefore in sleepy diseases the antient Physicians plucked the hair out of the nostrils, scourged the limbs with nettles, and applied acrid substances to different parts of the body, in order to remove the too great sleepiness by exciting pain.

[Fever.] Intense pains are almost continually followed with a fever; even in those diseases, which are not inflammatory in their own nature, as the gout, venereal disease, &c. For the acute pains in those diseases

iseases are always accompanied with some degree of fever.

Hence Hippocrates justly acknowledges pain among the causes of fevers in many parts of his works. Thus he says, (a) *Ex vehementibus doloribus obortæ febres diurnæ.* (b) *Febres ex hypochondriorum doloribus malignæ,* &c. “Continual fevers arise from violent pains: and malignant fevers from pains in the hypochondria, &c.” And when the head of the humerus has been dislocated backward, he says it is of all the ways most painful, and excites violent fevers, &c. And again (c), unless the dislocated joint of any kind be speedily reduced, a fever will arise from the pain, even in the most healthy person.

Since therefore a fever generally follows any severe pain, it is easy to conceive, that heat will arise as the effect of the increased motion of the juices in the fever; and by the consumption or exhalation of their more fluid parts, dryness will also be the consequence of pain. But heat and dryness in the body are always attended with thirst, whence plentiful drinking is a remedy in those maladies; as we shall hereafter observe in treating on thirst in fevers.

Convulsions.] Especially in those who have their nervous system very moveable or subject to irritation. Therefore infants frequently fall into convulsions from being griped in their bowels by an acid. I saw an hysterical girl, who being subject to the tooth-ach from a carious tooth, was frequently convulsed all over her body when the pain returned. She perceived the convulsion seizing her, in the manner which Galen did from the pain which he felt after straining his shoulder, which he thought had been luxated; of which we took notice in the comment to §. 164.

Gangrene.] This is defined to be that condition of the soft parts in which they tend to mortification, from

(a) Prænot. Coacar. No. 75. (b) Ibid. No. 31. & Lib. I. pro-rhet. Charter. Tom. VIII. pag. 738. (c) De Fracturis, Charter. Tom. XII. pag. 267.

from a destruction of the vital influx and efflux of the juices. So that with respect to the aching nerve, violent pain it is that state in which the parts tend to mortification from too great a distraction, from whence they will be entirely broke in sunder in a short time. When a violent pleurisy afflicts the patient with intense pain, if it be not speedily relieved, either the patient will be suffocated from his respiration being impeded by the violent pain, or else a livid spot arising in the affected side will denote a fatal gangrene. In the inflammatory iliac passion, after the severe pains, a gangrene will be formed in a few hours, and then the pain ceasing, death speedily follows. In the worst species of the paronychia, the end of the finger is often so violently affected by the intense pain, that the soft parts are destroyed in a few hours and turn to a gangrene, whence the bone of the affected finger falls off carious. But the pain is followed with a gangrene, more especially when a violent fever and inflammation are present at the same time; for then the impetus of the circulating juices being increased, speedily destroys the parts.

S E C T. CCXXVII.

WHENCE also we perceive, that there are different anodynes, according to the different causes of pain.

There is but one proximate cause of pain, and that is such a disposition of the nervous fibres arising from the brain as threatens their rupture; every thing therefore which removes that disposition of the nerve will ease the pain. But as that disposition of the nerve may arise from so many different causes, therefore as many different anodynes will be required to remove each of those distinct causes. It is therefore requisite for the Physician to know the particular cause of the pain, next to the proximate one, before he can

determine what remedy will remove the cause or causes of pain, as enumerated and reduced to distinct classes in §. 224. and in the following paragraph adequate remedies are proposed for those causes.

S E C T. CCXXVIII.

THE cause of pain is therefore removed
 1. by relaxing the distended fibres; 2. by resolving what is concreted; 3. by lessening the motion and quantity of the distending matter; 4. by removing the unequal and violent distraction of the parts; 5. by obtunding what is acrid; or, 6. by removing the same; or, 7. lastly, by extracting what lacerates or divides the fibres.

Such a distraction only of the nervous fibres as endangers their continuity will excite pain; if now art can procure the distraction to continue without danger of a rupture in them, the pain will cease, or, at least will be greatly diminished, even though the distracting cause continues to act upon the nervous fibres: if you endeavour to bend a piece of dry and stiff wood, it will break; but if you first soak it a while in water, it may then be bent without breaking. Thus is a willow twig variously twisted without breaking; but when it is dry, it breaks even with bending. Hence it is that such remedies as relax and mollify the solid parts of our bodies, have been used in all ages for relieving painful distempers. In the iliac pains, Hippocrates directs to anoint with oil, and to use the warm bath; in a pleurisy, he orders the affected side to be covered with emollient applications warmed, and the like he also orders to be used internally. Galen relieved the most intense pain, and the convulsions thence approaching, in himself, by procuring warm oil to be continually poured over the part (see §. 164). When a phlegmon or inflammatory tumour has distended

stended the skin, and subjacent panniculus adiposus, so as to distract the cutaneous nerves, and excite severe pain, even when it cannot be dispersed, but tends to suppuration, so as not only to continue but increase the distracting cause; in this case the constant application of an emollient cataplasm will so relax the nervous fibres, as to ease the pain, so that they are either more easily ruptured, or else continue to be distracted without danger of breaking. Thus all soft expressed oils taken in large quantities, happily relieve iliac colic, and nephritic pains. The vapours of hot water, and every thing that mollifies and relaxes, are therefore used with success in all pains. When intense pains arise from the puncture of a nerve, the most expert Surgeons foment the parts day and night with the most emollient applications. Hence all emollient and relaxing substances afford an universal remedy for easing all pains, because they remove the proximate cause of pain in the nervous fibres, *viz.* their danger of breaking; whereas the rest of the anodynes act only upon the remote causes of pain. Even when the particular cause of the pain is unknown, these remedies may be always safely and successfully used: and they have also this advantage, that while they remove many of the remote causes of pain, they do not increase those causes of it which are not removeable. When they have relaxed the vessels, the distending and impervious juice will then have a ready passage, and its acrimony will be at the same time obtunded. But every thing which augments the strength and contraction of the solid parts, while the distending cause continues to act upon the fibres, will always increase the pain. Hence pleurisies are observed much more severe in strong and laborious people, than in those who are of a lax and weak habit. Luxations are also reduced with much more ease, and with less pain in these last, than in people of a tense habit; and even in some, the ligaments are so easily elongated, that their limbs are disjoined without any pain. And when

When the executioners have violently extended all the limbs of criminals in the way of torture, they know that by pouring cold water upon them the pain becomes still much more intense. Therefore whenever the action of laxative and emollient remedies can reach the seat of pain, they will always have the desired effect. If, for example, a tense fibre of a nerve aches in the middle of a tooth, that pain cannot possibly be eased by emmollients; and the same is true when intolerable pains arise from an affection of the medulla of the bones; and also in the worst species of the paronychia, when the seat of the pain is in the tendons of the flexor muscles of the fingers, confined by their cartilaginous capsules. It may also sometimes happen, that though the pain is very severe, yet the use of relaxing and emollient remedies may be prohibited by the other symptoms: thus emollients would be pernicious in a latent or ulcerated cancer to abate the pain; because they would greatly augment the putrid and fungous excrescence which attends the disorder. But in almost all other cases, the emollient and relaxing remedies are of universal service for easing pains.

2. When pain arises from a calculus impacted in the ureter, whatever can dissolve the stoney concretion will relieve the pain: and every thing which can attenuate the inflammatory spissitude of the blood in a pleurisy, will also ease those pains. And the same is also true in all other cases, where pain arises from an obstructing impervious matter occluding the vessels, or from tumours formed by accumulations and concretions of the humours pressing and distending the adjacent parts. Under the head of obstruction, we treated of the various manners in which the particles of our fluids may concrete or cohere (§. 117.): and we also here described the several remedies capable of dividing and breaking those cohesions (§. 132. to 137.). Hence we perceive that the particular nature of the concretion must first be discovered; and then a remedy may be

be found from what we said before, which by dividing the concretion, will also remove the pain thence arising.

3. All pain supposes life residing in the part; and if the pain arises from some impervious humour distending the obstructed vessels, it will always be the more severe, as the *vis vitæ* is more potent or active. Hence in pleuritic fevers, the pain is almost intolerable, because the fluids are violently urged into the obstructed parts, and by dilating the vessels, they very forcibly distract the nervous fibres composing the coats of those vessels. Every thing therefore which abates the impetus and velocity of the circulating juice will ease pain; the truth of which we are assured of by daily observation. Thus phlebotomy continued even *ad deliquium*, often instantly removes, or at least abates the most acute pains in a pleurisy. Hence bleeding 'till the patient faints is so much recommended by the ancient Physicians, for relieving the most violent pains, as is evident from the instances we before acknowledged in §. 141. (a) And as we observed before upon another occasion (§. 133), Galen cured himself of a continual pain, fixed chiefly in that where the liver is attached to the diaphragm, by dividing the artery which runs betwixt the thumb and fore finger and letting it bleed 'till it ceased of its own accord. (b) For the same reasons the Ancients ordered strict rest in all acute diseases, in almost all which, there is continually a severe pain in the head. Nor does blood-letting prove serviceable in those cases, barely by weakening the force of the heart and motion of the blood; but also by diminishing the quantity of the last, and lessening the mass of distending humours. Plethoric people are often troubled with severe pains of the head, though the motion of their blood be very

(a) Galen. Comment. I. in Aphor. Charter. Tom. IX. pag. 40 & libro de Curandi ratione per Venæ Sectionem, cap. 12, Charter Tom. X. p. 441.

(b) Ibid. cap. 23. Charter, Tom. X. pag. 451.

ry sedate, or even almost suppressed, from the too great quantity of juices to be moved: but when a spontaneous hæmorrhage happens from the nose, or a considerable quantity is discharged by art, by diminishing the quantity of the blood, the pain ceases; merely from removing the distending matter with which the vessels were too full.

But a diminution of the vital motion is not only serviceable in these cases, where the vessels are in pain from too great a velocity or a distention by the fluids; but it is also highly useful in easing pains which arise from acrimony in the juices. For acrid particles are set into action by the *vis vitæ* and heat of the body, and may by that means do great damage; but they produce little or no effect in a body where all motion ceases, and the heat is no greater than that of the common atmosphere. Thus M. PETIT has demonstrated, after Helmont, that cantharides applied to a dead body have no effect; and even a potential utery applied fifteen hours to the skin of a dead body, produced little or no effect; but when the same part was fomented by the application of warm cloths over the caustic, it then dissolved the skin and part of the subjacent panniculus adiposus. (e) It is always observed in diseases where the acrimony of the juices excites pains, that by increasing their motion or warmth (which last is a consequence of their increased motion) that then the pains become more severe. Those nocturnal pains which so cruelly afflict some patients in the venereal disease, are often so much augmented by the warmth of the bed, that the miserable patient is then obliged to sit up every night, to lessen the pain by cooling the body. When an acute fever takes a person violently afflicted with the scurvy, the scorbutic pains are then immensely greater; and the vessels being suddenly ruptured by the impetus and erosion of the acrid juices, hæmorrhages follow in divers parts.

(e) Acad. Royale des Sciences, l'an. 1732. Mem. pag. 314, &c.

parts. In the like manner do we observe the scurvy exasperated by a warm air. (*d*) And there are more observations to confirm this truth; but those mentioned may suffice.

In what manner, and by what remedies, the motion of the fluids may be diminished in the vessels, we before described in §. 102 to 106; but the distending matter can be only removed by evacuants.

4. When a bone is luxated by the slipping of its head out of its cavity in the articulation, it distends the ligaments, and presses upon the adjacent parts from whence arises pain, which speedily ceases, or at least very much diminishes, so soon as the bone is replaced in its cavity; but then some smaller degree of pain generally remains a while after the luxation is reduced, from the great distraction which the ligaments lately suffered, and by which they are often inflamed. The same is also true with regard to the pain arising from an unequal and continual distention of half-divided tendons; for the pain instantly removes by placing the parts in a proper and relaxed posture, and retaining them so by compress and bandage; as is evident from the history we gave in §. 164, of a man who broke that part of tendo Achillis, which belongs to the Gastrocnemius muscle, while the other part of the same tendon remained entire, which arose from the Soleus muscle. There the pain ceased, after the inflammation was appeased by repeated phlebotomy, and the unequal distraction of the tendon removed by a proper bandage and dressings. (*e*) But when the distracting cause of the pain cannot be removed, as when a luxated bone cannot be replaced, because of the great tumour and inflammation of the circumjacent parts, then only emollient and relaxing remedies are useful by rendering the nervous fibres capable of elongation without danger of breaking.

5. When pain arises without any apparent increase of motion

(*d*) Acad. des Sciences, l'an. 1699. Mem. pag. 245.

(*e*) Ibid. l'an. 1728. Mem. pag. 334.

motion of the juices, without any signs of too great distention of the parts by a concretion or an accumulation of the juices, or without any external distracting violence, we then have great reason to think acrimony to be the cause, which is yet frequently accused as the source of pain, when it in reality arises from different causes. For we do not often observe any great acrimony in the blood; and if acrid juices were to flow through the very tender vessels of the encephalon, they would quickly be destroyed. Hence the general seat of acrid juices is in the *primæ viæ*, or in other parts of the body where the humours become acrimonious by their stagnation or extravasation; either from a spontaneous degeneration by their own nature, or by a particular cacochymy, as in the scurvy, venereal disease, &c. and therefore this disorder, or cause of pain, is generally topical or confined to particular parts. If therefore acrimony appears to be the cause of pain, it is evident, the pain will be removed or mitigated, if the eroding acrimony be obtunded. But this must be done, either by specifics of a directly opposite nature to the known acrimony; as for example, by earthy absorbents or alkaline salts, when an acid acrimony is seated in the *primæ viæ*; or else by such remedies as are averse to all kinds of acrimony, viz. such as dilute, obtund, or sheathe them, &c. for by these all acrids become inactive, as we demonstrated in speaking of the spontaneous acrimony of the juices, to be corrected by these remedies.

6. When in the venereal disease the malignancy of the disorder infects the bones, by a slow erosion and distention of their exquisitely sensible periosteum, the most severe pains are excited. But when in these cases the body is filled with a large quantity of decoction Guaiaci, and then a sweat promoted by the burning of spirit of wine, the decoction is then moved through all the vessels, their latent virus is thereby deterged and exhaled out of the body, so as entirely to remove the pain, or else greatly relieve the patient.

The same method will also obtain, when a person wounded has any remarkable cacochymy, as the scurvy, for example; for then the acrid humours being brought to the wound, by speedily increasing their acrimony there, they may excite a pain; in which case all softening and diaphoretic remedies, of which vulnerary decoctions are generally composed, being drank in large quantities, the sharp and irritating juices will be thereby weakened and washed away.

7. So long as, for example, any fragments of the wounding instrument, splinters of the fractured bone or other such like irritating body remains in the wound which by its sharp figure and rigidity may injure the sensible parts, so long will the pain continue, because the parts are thereby continually irritated, inflamed and tumefied: the parts of the wound will be therefore continually lacerated by the action of the foreign body 'till it be either extracted by some chirurgical instrument, or discharged with the suppurated matter formed round it. But in what manner, and with what cautions these foreign bodies are to be removed from wounds, we have before described in §. 186, 187, 188.

S E C T. CCXXIX.

THE sense of pain is removed while its cause (224) remains; 1. By rendering the nerve unfit for sensation, by compressing, dividing, or burning the same; 2. By obtunding the common sensory, by the force of narcotics: and by these means some of the symptoms (226) or effects arising from the sense of pain, are likewise removed.

The best of all methods for curing pain is that which removes its cause; but sometimes the cause is concealed in the most severe pains; and frequently its causes are not removable when known. In the meantime this racking sensation requires some relief, since

its effects or consequences, as restlessness, watchings, fever, &c. may produce fatal events in the body. In this last case, all that art can perform is to take off the sense of pain, though its causes continue; but the sense of pain arises when there is a free commerce betwixt the brain and the affected nerve, the functions of the brain at the same time being unaffected. All remedies therefore which remove the sense of pain, without reaching its cause, do it either by acting upon the aching nerve, or upon the brain itself.

1. It appears from the most certain observations, that if the only nerve which belongs to a part is destroyed, all the sense of that part is lost (*per* §. 162): or the change made in the extremity of the nerve, which so affects the sensorium, as to excite the idea of pain in the mind, is communicated to the brain by the continuity and sound state of the nerve; everything therefore which destroys the integrity of the nerve betwixt the brain and the part of the body where the cause of pain acts, will remove the sense of pain, even though the cause continues, and remains acting with the greatest violence. Those who have the medulla spinalis compressed by a luxation of the spina dorsa, do not perceive pain in their legs, even though you apply actual fire to them. Nor does it matter in this respect whether you intercept the commerce betwixt the brain, and the part affected, by compressing, dividing, or burning the nerve, if you do but destroy its continuity. When the vessels are compressed by a strict ligature made upon a limb, in order to prevent an hæmorrhage in its amputation, the same stricture compresses and stupifies the nerve so, as to greatly diminish the pain of the operation. A certain quack at Amsterdam cured the tooth-ach, by twisting the fingers in the person's hair, and then by forcibly compressing his thumb under the lobe of the ear, so as to contuse the nerve which there passes, and sends branches to the teeth of the upper jaw; and he produced the same effect by compressing the nerve

which enters the lower jaw, under the first of the grinding teeth on each side. All such things assuage the severest tooth-ach, which destroy the aching nerve in the substance of the tooth: and hence, the tooth be broken and carious, the operator instantly relieves the pain, by cauterising it with a red hot iron probe, provided the cauterising instrument can reach the aching nerve. This method of curing the tooth-ach was formerly recommended to us by Hippocrates where he says, (a) *In dentium autem doloribus, si deerosus fuerit & vacillet, eximatur. Si neque erosus fuerit, nec vacillet, ustione resiccandus est*: “ In pains of the teeth, if the tooth be hollow and loose, let it be pulled out; but if it is neither loose nor carious it should be remedied by cauterisation.” Others cure the tooth-ach by caustic distilled oils, as of clove origanum, &c. which being conveyed into the hollow of the tooth, instantly burn up or destroy the aching nerve which they touch. Hippocrates generally proposes either cauterisation or scarification for most other pains which obstinately resisted the efficacy of other remedies; removing the sense of pain in both cases, by destroying the aching nerve. And thus, after having recommended many remedies for the head-ach, he adds (b): *At si diuturnus & validus capitis morbus evadat, neque capite purgato tollatur, a hujus caput scarificare, aut venas in circuitu adure oportet: ex cæteris enim ad hoc duntaxat sanum fore sperest*: And again, (c) *In capitis dolore sanguinem ex venis detrabito; quod si non cesset, sed diuturnus sit, venam inurito, & convalescit*: “ That if the malady be violent and continual, and does not give way to purgation of the head, the veins in that part ought then to be either scarified or cauterised, for these are the only means left to relieve the patient.” And in another place he says, “ That in the head-ach you must

(a) De affectionibus, cap. 2, Charter. Tom. VII. pag. 621.

(b) Ibid. pag. 620.

(c) De locis in homine, cap. 14, Charter. Tom. VII. pag. 373.

must take some blood from a vein ; and if the pain does not cease, but still continues, cauterise the veins, and the patient will be cured." The like advice he also gives us in other places, for curing the head-ach by cauterisation ; and in the troublesome sciatica he directs. (d) *Quamcunque partem dolor occupaverit, balneis, fomentis, linimentis emollire, & alvum subducere, levato dolore gurgans exhibere, post hæc lac asinum potare, &c. si in unum aliquam locum irruerit dolor, & constiterit nec medicamentis expellatur, inurito, quocumque in loco fuerit :* " That whatever part the pain invades should be treated with baths, fomentations, and emollient liniments, keeping the bowels loose ; when the pain is gone off, give a purge ; and afterwards let the patient drink asses milk, &c. but if the pain settles in some particular part, and does not give way to medicines, cauterise the part wherever it be seated." And he in another place orders in the same disease, that if the pain is not relieved by the use of various remedies, to let the part be cauterised with many and deep eschars, in fleshy parts by iron cauteries, and in bony parts by the burning of fungi (e). The same he also repeats in his aphorism (f), and in some other places of his works.

Hence it is that the burning of moxa is so much used in Asia, for easing pains of the gout, and even for removing the gout itself : to do this they take the old leaves of a kind of mugwort, which being beat and separated from the hardy and woody fibres, are then twisted into little pyramids, the basis of which is applied to the aching part, and then by kindling the apex or tip of the pyramid, the fire gradually descends and burns the part, and that without any great torture, since Kepfer says, he had seen the cauterisation suffered by an hundred children without

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their

(d) Hippoc. de affectionibus, cap. 8. Chart. Tom. VII. pag. 629.

(e) Hippoc. de internis affectionibus, cap. 53. Chart. Tom. VII.

pag. 677. (f) Aphorism. 59, & 60, Sect. VI.

their crying or making any signs of pain (g). Hence the use of moxa is so frequent in those parts, that a great many people burn themselves with it, in several parts, every six months, by the way of preservation of their health; and even some permit themselves to perpetual imprisonment, to enjoy the benefit of this operation.

But as this method destroys the nerve and its functions arising from its continuity, therefore this way of easing pain is never used but when unavoidable, from the severity of the torture; and when the remedies enumerated in the preceding paragraph have been tried to no purpose; or lastly, when the condition of the aching part is such, that it will not admit of the application of those remedies to ease or remove the pain.

2. When the cause of the pain cannot be removed, and when it is altogether improper or impracticable to destroy the aching nerve, without greatly injuring the parts which depend on its continuity, there then remains only one method of relieving the patient, by introducing such a change in the common sensory, as renders it insensible. For the cause of the most intense pain may exist in the body, without any sense of it in the mind, notwithstanding the nerves are at the same time entire, as we see in those who are either apoplectic or dead drunk, in both which cases the senses are absent. Now we are by medicine furnished with such remedies as will remove the sense of pain from the mind for a certain time, though the cause of the pain can by no means be corrected or removed; and these remedies are, from the stupidity which they induce, termed narcotics, (see more of these in §. 202.) The chief of these narcotics is opium, which by a wonderful property, not easy to explain, removes the sense of pain, while it continues in the stomach. For one grain or two of opium being swallowed will continue in the stomach a long while, its tenacity and re-

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(g) Kæmpfer. Amœnitat. Exotic. pag. 592, &c.

uous texture rendering it not easily dissolvable, so that it will generally quiet the sense of pain for eight hours at least; and what is yet more surprising, the little pill of opium shall be frequently vomited up undissolved the next morning. Whence opium does not act by dissolving and mixing with the humours, so as to pass by the laws of circulation to the brain; but by remaining in contact with the internal surface of the stomach, it produces such a change in the nerves there distributed, as blunts the sensitive faculty in the brain. And how great a force the nerves have, which are spent on the stomach, in affecting *sensorium commune*, will appear from many diseases hereafter, in which all the actions of the brain are perverted, even though the cause of the malady remains only in the stomach. Corrupt bile lodged in the cavity of the stomach, excites uncommon head-achs, vertigos, madness, &c. all which maladies disappear upon discharging the offending matter by vomit. This system is also confirmed from many instances of poisons, which while residing in the stomach, have yet surprizingly changed the whole body; and when they have been discharged from thence, all the symptoms have disappeared. We have an instance in Wepfer (*b*) which very well confirms this doctrine; viz. of two boys and six girls, who meeting with some roots of the *cicuta aquatica* in the meadows, eat them for parsnips; but after they had got home, the two boys died miserably convulsed, they discharging none of the poison either by vomit or stool; yet the girls all escaped by timely vomiting up the poisonous roots. But one of those girls recovered sooner than the rest, because being convulsed with her jaws open, the father poured down an infusion of tobacco leaves in spring water, which quickly made her vomit up the roots she had eaten with great violence; after resting a while on the bed, she asked for victuals, and said she was very well; but the father suspecting that some of the remains of the poison

(*b*) *Cicut. aquat. histor. & noxæ*, pag. 5. &c.

poison lay still concealed in the stomach, gave her another infusion of tobacco, which brought up a great deal of bile and mucus, and the child sleeping well all the night, arose chearful in the morning, walked about, and lived in good health afterwards. Experiments were afterwards made with the same roots on dogs, by which it appeared that all those direful symptoms consequent on taking it, vanished immediately, by causing the roots to be vomited up again. From all this it is evident, that the simple contact of the poison, with the internal surface of the stomach, produced so many terrible symptoms without any mixture of the virulent juice with the animal fluids circulating; otherwise the symptoms would not have been so soon removed upon discharging the roots by vomit, since what had gone farther than the stomach would have still continued to act and disturb the body.

Hence it therefore seems very probable, that opium lying in the stomach, so changes the nerves of that viscus by its contact, as will produce an alteration in the common sensorium, sufficient to render the mind incapable of perceiving pain, though its cause, and the integrity of the nerves still continue. And it seems to be a divine providence that has granted this circumstance to mankind, that those enormous pains may be eased for a time, whose causes are either not removable at all, or not without a long course of remedies. Hence Sydenham being convinced by much experience of the efficacy of opiates in this respect, concludes, that without those remedies the art of Physic would be lame and imperfect: and he adds, that the most boasted preparations of opium do neither increase its virtues, nor correct that imaginary malignity which many falsely suppose to reside in it. (i) And we are assured that opium prudently exhibited in a just dose has been continually used for several months running, without any bad consequence. It was therefore deservedly said by Joannes Terentius Lyn-

(i) Dyfenter. part. anni 1699, &c. pag. 230, &c.

Lyncæus (*k*), in his notes to the *Theſaurum Rerum Mexicanarum novæ Hiſpaniæ* of *Franciſcus Hernandes*, that ſince all the eaſtern and ſouthern nations daily uſed opium, datura, bangué, &c. without detriment, it was pity ſuch an infinite number of mortals ſhould periſh by the tortures of pain, for want of knowing this remedy, who might have been ſaved from the jaws of deſtruction, if the Phyſicians of theſe parts would be perſuaded into the frequent uſe of it, by the conſent or example of the reſt of the world. And though *Proſper Alpinus* (*l*) condemns opium as poiſonous, he is yet obliged to confeſs that the *Ægyptians* daily take it without any detriment, even though by gradually increaſing its doſe they ſometimes take it in the quantity of three drams. But if thoſe who have been long accuſtomed to the uſe of it, ſuddenly abſtain from it, they ſuffer faintings and other very grievous ſymptoms, 'till they return again to their opium, or elſe ſupply its place by plentiful drinking of Cretic wine, which is very ſtrong, joined with ſpices.

It cannot indeed be denied, that opium, imprudently uſed in too large a quantity, may produce convulſions and a fatal apoplexy ; but then there are a great many remedies beſides, which are daily uſed with ſafety in a juſt doſe, but are pernicious in too large a doſe. We have a notable inſtance in the hiſtory of the Academy of Sciences (*m*), which may ſerve to illuſtrate the virulency of opium, if given in too large a doſe to ſuch as are unacquainted with it. Some young men of *Coptha* endeavouring to conquer one of their companions at their cups, who boated he could out-drink any of the reſt, diſſolved a dram of opium ſecretly in one of the veſſels of wine, and gave it to the unfortunate hero to drink ; but in a few hours after he became raving mad, and then fell down in a dead

(*k*) *Hernand. Rerum Mexican. novæ Hiſpan. Theſaurus*, p. 114.

(*l*) *Proſper. Alpin. Medic. Ægypt. Lib. IV. cap. 1. p. 255, &c.*

(*m*) *Acad. des Sciences, l'an. 1735, hiſt. pag. 6.*

dead sleep : the next morning, his companions coming to insult him for his being conquered, found him lying without any pulse, of a livid colour, and near expiring ; and in a little time longer, after the fruitless trial of some very potent remedies to recover him he expired, about fifteen hours after the opium was taken. His arms and thighs appeared deformed with livid tumours as big as an infant's head of four months old, with an intolerable stench : and near an hundred cats from the neighbourhood came by troops, and fell a licking the carcase so greedily, that they would certainly have devoured it, if they had not been prevented.

This wonderful instance, indeed, proves, that an enormous quantity of opium given to one unaccustomed to it, produces the most malignant symptoms, and even death itself ; and even that it corrupts the fluids of the human body with the force of a poison. But we are daily convinced by an infinite number of experiments, that it is a safe remedy when prudently exhibited : nor ought it to be under-valued, because it only removes the sensation, and not the cause of pain. For it is a great matter in some diseases to be able to relieve the pain ; and our obtunding the sense of pain by narcotics, need be no hindrance to the use of other remedies for removing the cause of the pain, when it is discovered. But it cannot be too well remembered, that though there is no sensation of the pain, yet the cause continues to destroy the body. For while the pain is eased in the most inflammatory diseases, as, for example, in a pleurisy, the severe inflammation continues to destroy the affected vessels, forms a gangrene, and the patient awaking out of his forced sleep, often expires suddenly after. Such a fatal event is then ascribed to these remedies, when it only followed, because the Physician not being admonished by the complaints of his patient, imagined the disorder was abated, when in reality it rages with equal and often greater violence, after the use of such

remedies.

remedies. For while a deep sleep is thus produced by suppressing all the animal motions, the vital motions are in the mean time increased: but those vital motions, in inflammatory diseases, are already offended by their too great velocity; and therefore the use of narcotics in such diseases can never be safe, unless the violence of the disease has been first broke by plentiful bleeding and other evacuations, &c. This too is a circumstance carefully observed to us by Sydenham, who was well acquainted with the salutary effects of narcotics in most diseases, and very freely used them (*n*). But in what manner, and with what cautions narcotics may be safely administered, we have already declared in the commentaries to §. 202.

In short, these remedies remove all those effects which follow from the sense of pain; such as uneasiness, tossings or restlessness, and especially watchings or want of sleep; but all the other effects resulting from the cause of the pain, still continue to destroy the affected nerves, though now insensible of pain,

Of CONVULSIONS.

S E C T. CCXXX.

A Violent involuntary and alternately repeated contraction of a muscle, is termed a convulsion.

In this place we consider convulsions arising from wounds, as the cause; but we shall hereafter consider (in §. 710.) the convulsions of fevers separate, which arise from very different causes, and which therefore require a very different method of cure.

Every convulsion is a disorder of some muscles; and since muscles in action contract or draw their tendons;

(*n*) Sydenham. febris contin, ann, 1661, &c. pag. 81, 82.

dons ; at every alternate action of the muscles the tendons will be first contracted, and then relaxed again : and hence a subfultus of the tendons is sometimes thus denominated by Physicians, when they perceive the tendons of the muscles playing under their fingers in feeling the pulse. And since the tendons were by the Ancients (*a*) comprehended under the general appellation of nerves (for by the term *νεῦρα* they called the tendons and ligaments, as well as the nerves continued from the brain and spinal medulla) : and therefore Celsus calls this disorder a distention of the nerves, which the Physicians of the present day call by the usual name of convulsions.

But in every convulsion there is a contraction of the muscle, which if produced voluntarily is not morbid ; and therefore it is said in the definition to be an involuntary contraction of a muscle. It is also required in a convulsion for the muscular contraction to be violent, or else there would be no distinction betwixt a convulsion and a tremor, in which last the muscular contractions and relaxations are also involuntary and alternate, but then the contractions are weak, and in a convulsion they are violent. And lastly, is added in the definition, that this muscular contraction is alternately repeated, ceasing a little while, and then returning again.

But it must be observed, that if the cause, whatever it be, which occasions a muscle to contract against the will, continues its action without any intermission, then the muscle will remain continually contracted, so long as the contracting cause continues to act. But it is evident, this last case ought to be referred to convulsions, since the occasional causes are the same, which produce the involuntary and alternate contractions of the muscles, but now being permanent, cause a continued contraction and stiffness of the muscles. This is evident in epileptic fits, where the muscles are

(*a*) Galen. de usu part. lib. XV. cap. 1. Charter. Tom. IV. pag. 656.

alternately convulsed during the paroxysm, but a little after they become rigid like a statue, by a lasting contraction of almost all the muscles in the body. The disorder which the modern Physicians call a convulsion, was, by the ancient Greeks, called (*σπασμὸν*) a spasm; but when the muscle continued stiff in its preternatural and involuntary contraction, they then called it (*τέτανον*); the same kind of disorder is also by Celsus termed a rigor; but a spasm or cramp he calls a distention of the nerves (*b*). The term convulsion is found used in this sense only among the modern Physicians; though the word *ἐκτονικὴ*, which may be very well translated convulsion, is to be found in Aretæus (*c*), where he treats of a tetanus and its kinds: but he seems to have used the term spasmus and tetanus promiscuously for each other, and to denote the same affection, as is very apparent from the same chapter. And Galen tells us, (*d*) *Quod tetanus sit convulsio: sed in tetano partes convelli non videntur, quod æque antrosum ac retrorsum tendantur*: “That a tetanus is a convulsion, only in a tetanus the parts do not seem to be convulsed, because they are equally pulled as well forwards as backwards.”

From hence we may conclude, that though the term convulsion is at present used to signify a violent, involuntary, and alternately repeated contraction of a muscle; yet in a more general signification, that term may also denote such a violent and involuntary contraction of a muscle, as continues a long time without any remission; more especially as some use the term promiscuously for both, and as they frequently arise from the same causes, and affect the same parts, *viz.* the muscles. But that species of convulsions in which the muscles continue extended, has been distinguished into three kinds; a *tetanus*, when the body is convulsed in a straight direction, without inclining

(*b*) A. Corn. Cels. Medic. lib. II. cap. 1.

(*c*) Aret. Cappad.

de causis & signis morb. acut. lib. I. cap. 6.

(*d*) Comment in

Sect. 4. Aphorism. No. 57. Charter. Tom. IX. pag. 171.

inclining any way; *emprosthotonus*, when the body is contracted forwards; and *opisthotonus*, when the body is drawn backward by the contraction of the muscles. Lastly, a tetanus may be either universal, when all the muscles in the body are convulsed and rigid in an instant; or else it may be particular, as when the muscles of the jaw, mouth, or other particular parts, are contracted, &c.

S E C T. CCXXXI.

THE cause of which is any thing that forcibly impels the nervous juice alternately into the convulsed muscles,

We observe this wonderful faculty in man, that he can either move or hold still the muscles, subject to the will at pleasure, and increase, diminish, or direct their motion as he thinks fit. And yet these very sensible motions excited in our bodies, which change other bodies with such a mechanical force, seem scarce to arise originally from any thing corporeal; and all of them are performed without a knowledge either of the cause or instruments required therein; since the most expert anatomist does not perform those motions better than the innocent child. But it is the most wonderful of all, that in exciting these motions there should appear no physical change in the body, but only in the parts changed, *i. e.* the muscles; and that after suppressing the motion by the influence of the will, there should remain no change or footsteps as a sign thereof: but the whole may be performed in so small an instant of time, as to be scarce discernible; since a person no sooner wills the elevation of his arm but it is instantly done. We are taught by physiology, that nothing more is required to this action, than a free commerce betwixt the brain and the muscles by the nerves, which are contained from the me-

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ulla of the brain to the voluntary muscles. Since therefore a convulsion appears, from the definition given of it, to be such a motion excited and suppressed alternately, and since we can imitate the said motion at our pleasure, as the beggars who feign epileptic fits well know it is therefore evident, that a convulsion may arise from any cause which can excite such a change in the muscles by the nerve, against the inclination of the will, as a healthy person produces by the same change made with the influence of the will. And since the manner in which the voluntary motions are excited lies concealed from us, and we are only acquainted with the fact by observation; so the change made in the common sensorium by which the convulsion is excited, may lie equally concealed from us. All that art can do in this case, is to observe those changes in the body which follow from such an involuntary contraction of the muscles, and then to remove or correct the changes observed; which may be done without at all knowing by what means those changes in the body affect the common sensorium, or that part of the brain where the changing of our ideas result, from the changes or impressions made in the body; and where also, changes are made in the body by changing our ideas or thoughts.

But since it is evident from the observation of Physicians, that many accidents may happen in the body from whence convulsions may arise; and as we are here only considering them as the consequence of wounds chiefly; therefore we are to examine what can be found residing in the wound itself, from whence the convulsions are produced: and these causes are enumerated in the following aphorism.

S E C T. CCXXXII.

AND therefore the cause may reside in the wound itself, whether it be any foreign body irritating, or the condition of the nerves themselves

selves injured (163, 164, 165, 183, 184), or too much blood having before been lost.

Foreign bodies irritating.] The soft pulp, continued from the medulla of the brain, which constitutes the proper substance of the nerve, and which in the larger nerves is defended with so many integuments to convey it safely to the proper parts to which it is destined; if this be irritated by any thing acrid, or by any other body, which by the mechanical figure and hardness of its parts can injure or destroy the fair very soft pulp, it may excite a convulsion. But in wounds the nerves or tendons may be injured, or they may be so denuded of their coverings, that the irritating or acrid body may easily affect the soft pulp which is so very sensible of irritation. Even the most extraordinary pains and convulsions may arise barely from the contact of naked nerves, with liquor; they have not been used to: for when a little foetus butter, sugar, or the cold air, &c. touch the naked nerve of a tooth, which has been exposed by an erosion of their vitrious crust, the consequent pain has been so severe, as to fling the whole body into convulsions. And the touching of a tendon, bare of its integuments, has instantly flung the patient into a universal tetanus, as we observed in §. 164; when at the same time the tendons are pulled and elongated naturally without any bad symptom, while they are confined in their capsules, defended with an oily mucus. Since therefore these very sensible parts are often exposed or laid bare in wounds, the most severe symptoms may arise from some bony fragments or parts of the wounding instrument, &c. irritating those parts while they remain in the wound. The same will also follow from the humours extravasated in the cavity of the wound, becoming there acrimonious by stagnating; as also from the application of acrid remedies of any denomination, of which we gave an instance from Hippocrates in §. 164.

The condition of the nerve itself injured, &c.] We have already demonstrated at the numbers cited in this aphorism, that nerves or tendons being punctured, or half divided, produce convulsions, and other cruel symptoms; the truth of which assertion is confirmed by the numerous observations of Physicians.

Too much blood having been lost before.] Whenever the humours of our body are so much evacuated, that what remains circulating by the force of the heart is so small in quantity, as not to be able sufficiently to distend the vessels; then the arterial pressure upon the brain will subside, and from thence the motion of the spirits through the nerves of the brain will cease: whence will follow a palsy of all the muscles; and the cerebellum being also affected in the like manner, will cause a *deliquium animi*, from whence all the juices of the nervous and arterial system will begin to lose their motion. In the mean time the cold arising in the body, from the diminished motion contracting the solids, will impel the venal blood towards the heart, which being filled will also contract and drive the blood with a very great velocity through the empty arteries, there being now no resistance to the impelled blood. At that instant therefore the blood will be forcibly impelled through the vessels of the brain; whence the spirits will have a swift motion into the muscles, and presently again stop; and then return again to their motion, when the heart gradually filling contracts itself. Thus will the powerful cause of motion in the muscles act one minute, and cease the next; whence will follow a violent, alternate, and involuntary contraction of the muscles, which we call convulsions.

What we have here advanced, is confirmed by the observations daily made in the slaying of animals by the butcher; for when the blood runs in a full stream from the divided carotid arteries in a calf, sheep, hog, &c, they lie still; but towards death when the blood begins to run slow, and by starts, for the reasons

we before assigned, then those animals are always violently convulsed 'till they die. When almost the whole mass of blood has escaped from the open vessels of the uterus, after abortion, delivery, &c. the woman is then always convulsed, and frequently expires in a little time. The same has been also found true in weak habits, when too great a quantity of juices have been exhausted by an over-purging.

Hence Hippocrates informs us, (a) *Copioso sanguine fluente, convulsio aut singultus accedens malum*: "That if convulsions, or a hiccough follow a profuse hæmorrhage, the case is dangerous." And again he says (b) *Convulsionem fieri & a repletionem, & ab inanitione*: "That convulsions arise both from repletion and inanition." And he likewise affirms, (c) *Nimie purgationi succedere convulsionem & singultum*: "That convulsion and hiccough follow over-purging, &c." And the like he repeats in many other places. For this symptom following profuse evacuations, denotes that the discharge of our humours has been so great as to deprive the vessels of their due fulness and tension, whence the blood sent from the heart does not propagate its motion through full vessels, but runs impetuously into the empty vessels, whence the equable pressure required in the vessels of the encephalon is destroyed, though it is from thence that life and sense depend; hence appears how dangerous it is for convulsions to arise from inanition.

S E C T. CCXXXIII.

AND the effect thereof is known to be perversion of all the actions in the body.

The effects of convulsions are innumerable and surprising; for nothing in the whole body remains undisturbed.

(a) Aphor. 3. Sect. 5. Charter. Tom. IX. pag. 195.

(b) Aphor. 39. Sect. 6. Charter. Tom. IX. pag. 273.

(c) Aphor. 4. Sect. 5. Charter. Tom. IX. pag. 106.

disturbed, whether you regard the solids or the fluids, or the actions themselves which depend on them. For when the muscles become thus violently contracted and relaxed, or rigid and flaccid alternately, the passage of the blood through them is one minute impeded, and the next minute it meets with a very free and swift course through the relaxed muscles: the veins adjacent to the convulsive muscles will very speedily evacuate, when the venal blood will be accelerated towards the heart, which will be thus disturbed in its equable reception and expulsion of the blood. Respiration will be also frequently disturbed in an extraordinary manner, it becomes difficult and impracticable without the greatest strugglings, and sometimes a violent suffocation follows, as Aretæus hath well remarked, in describing the symptoms of a tetanus (a). Nor is there less disturbance to be observed in the animal functions: for those irregular contractions of the muscles are made without the design or will, and often without the knowledge, of the patient: frequently all the external and internal senses are either wholly abolished, or greatly perverted; at which we need not wonder, since convulsions denote that the corporeal organ of the brain is affected, upon which depends all our humanity. Nor are the natural functions without being disordered: for the jaws are frequently so strictly closed, that even a wedge cannot be forced betwixt the teeth to open them, the power of deglutition is absent, the stomach and intestines are wonderfully inflated, and the abdomen so much distended, as to be in danger of bursting. The sphincters of the bladder and anus are either contracted, so as to discharge nothing; or else relaxed, so as to let go their contained fæces unknown to the patient, &c. To sum up the whole in a word, the whole universal and every individual part of the body is frequently so much altered by convulsions, that even the patient's

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own

(a) Aretæi Cappad. de causis & signis morbor. acut. Lib. I. cap. 6. pag. 4.

own relations and friends do not know them; all which has been accurately remarked by Aretæus in the place before cited, and where he concludes: *Votum adstantibus, prius impium, nunc honestum efficitur, ægrum vitæ defungi, quo una cum vita doloribus & acerbis malis liberetur*: “ That it makes the by-standers think a wife
 “ impious in itself to be here honest, to have an end
 “ put to the patient’s life, that with life he may be
 “ also freed from the pains and severe maladies.”

For frequently, if the patient escapes, the most severe maladies remain, from the distortion of the limbs, the distraction of the muscles, the functions of the brain abolished, &c. Sad experience teaches us, that palsies, atrophies, foolishness, &c. frequently remain incurable during life, after the patient had been freed from violent convulsions.

Lastly, When all the vital, animal, and natural actions of the body, have been abolished by convulsions, sometimes death itself follows, and puts a period to such grievous maladies. Hippocrates (b) says *Vulneri accedens convulsio, lethale*: “ That convulsion
 “ following a wound, is a fatal sign. And Aretæus, in treating of convulsions in the place before cited, says *Nam ob vulnera fieri solent, membrana, aut musculi, aut nervi punctis, ex quo plerumque moriuntur. A vulnere enim convulsio lethalis est, &c.* “ For they arise
 “ from wounds, or punctures in the membranes, muscles or nerves, of which the patient generally dies
 “ For convulsions from a wound prove mortal, &c.”

S E C T. CCXXXIV.

THE cure is performed, 1. by removing the irritating body (186) by the skill of a Surgeon (187, 188); 2. by discharging or obtunding what is acrid; 3. by removing the condition of the nerve (231) by the remedies described (in

28, 229); 4. by filling the vessels with mild and fluid aliment, administered frequently and in small quantities; 5. by suppressing the hæmorrhage at the same time (218, 219).

There is an endless tribe of antispasmodic remedies mentioned by authors; but since convulsions arise from very different and often opposite causes, it is obvious to every body, that there can be no universal remedy assigned for them; but that the remedy ought to be determined from having first detected the cause of the malady, before we can remove that cause. But since convulsions following wounds, are either from some irritation made by something lodged in the wound, or from the nerves, tendons, or membranes being punctured or half divided, or, lastly, from too great a loss of blood; hence these three indications will direct the whole intention of the cure. So that the first and second number will treat on the methods of removing or mitigating every thing that gives irritation; the third number will comprise the remedies for removing the described condition of the affected nerves or tendons; and the two last numbers will indicate the means whereby the loss of blood may be suppressed, and a restitution made of that which was lost.

1. If a thorn be lodged in a nervous part, as under the nail, so as to injure the naked papillæ of the nerves, after the most intense pains, convulsions frequently follow, which are not easy to remove, so long as the thorn continues there. Therefore in the first dressing of a wound, enquiry ought as much as possible to be made, whether any foreign body of this nature remains in the wound. But how this is to be done, and with what cautions the extraction is to be made, we directed before in the numbers referred to in this aphorism.

2. Acrimony seldom arises in the juices brought to the wound, unless a cacochymy prevails in the body or unless much acrid food is eaten. But convulsions much more frequently arise from the application of acrid remedies to the wound externally, as when arsenic, or some other caustic substance, is imprudently used to nervous or tendinous parts wounded. When either of these is discovered, the acrimony must be either removed or corrected by such remedies as are known to obtund acrimony by an opposite quality. So that here again nothing universal can be determined towards a cure, but every particular acrimony will require a particular treatment. Soft balsams are in the mean time always serviceable, because they defend the parts from being eroded by the acrid particles; and at the same time they weaken their force by involving or sheathing their points with a fat oil with which they abound. See more in §. 228. numb. 5 and 6.

3. The cause of convulsions in wounds, is frequently such a condition of the injured nerve, as being partially divided, a distraction is occasioned on the fibres which remain entire; whence follow severe pains, convulsions, and other symptoms enumerated in §. 163 and 183. But every malady accompanied with pain, is produced in some measure from a flow, gradual, and constant distraction of the nervous fibres, and is evident from the definition of pain given at §. 220 and therefore such remedies as remove pain, will in the case remove convulsions arising from this cause. The remedies here must act either by removing the cause of pain by rendering the nerve unapt for sensation or by intercepting the commerce betwixt the nerve affected, and the brain; or, lastly, by so obtunding the common sensorium, that it cannot perceive the change made by the exciting cause of the pain. That all the remedies have been used with success in the cure of convulsions, will appear from what follows.

Among those remedies which are recommended for removing the cause of pain, §. 228, all such as are the
principle

principal, and of the most universal use, which are denominated laxative and emollient; by the use of which the nervous fibres are so disposed, that they may be extended without danger of a rupture; and such have been ever used for the cure of convulsions. To cure a tetanus, Hippocrates (*a*) recommends warm chicken-broth that is fat, and to apply warm fomentations of moist and oily ingredients, included in bladders, and applied every where, but especially to the aching parts; he also orders them to be frequently and plentifully bathed with warm oil. In another place (*b*), for a tetanus arising from a wound, he directs the parts to be fomented, warmed and anointed before a fire, sweats to be excited by the warm bath, for the patient to drink a warm aqueous emulsion if he is able, otherwise he recommends to pour it through his nose, &c. Again, speaking of warmth and its uses (*c*), he says, that it eases pain, and mitigates rigours, convulsions, and cramps: and on the contrary he asserts (*d*), that cold produces convulsions and tetanus. For heat relaxes any thing, so that it may be extended or bent without danger of breaking; whereas cold contracts every thing, and renders things brittle, as is evident to the experience of all people. The like is also recommended by Celsus (*e*), who directs the patient thus affected to dip his whole body in warm oil, or in a decoction of fenugreek, mixed with a third part of oil. And Galen himself avoided a convulsion, from a violent distraction of the ligaments of his shoulder, by continually pouring warm oil upon his arm, as observed before in §. 164. And the like is also recommended by Aretæus for the cure of a tetanus (*f*). Hence it is evident, that the ancient Physicians unanimously agreed in the use of emollient remedies for the cure

(*a*) De morbis, Lib. III. cap. 12. Charter. Tom. VII. pag. 587.

(*b*) De internis affectionibus, cap. 54. Charter. Tom. VII. p. 678.

(*c*) Aphorism. 22. Sect. V. Charter. Tom. IX. pag. 207.

(*d*) Ibid. Aphorism. 20. pag. 205.

(*e*) Lib. IV. cap. 3.

(*f*) De Curat. morb. acutor. Lib. I. cap. 6. pag. 85, &c.

cure of convulsions, which remedies surprisingly ease almost all kinds of pains.

It is also very evident, that if the nerve, whose disorder affects the common sensory, can be divided without the hazard of any very bad consequences, or if it can in like manner be compressed, or destroyed by the action of caustics, &c. there will then be no danger of future convulsions; because the commerce betwixt the brain and the injured nerve is thus intercepted. This is confirmed by experience in the cure of a species of the epilepsy, in which the patient perceives a kind of titillation in some particular part, as in the great toe (which is a case I once saw), like as if an ant was creeping up the part; this motion ascends through the leg to the thigh, abdomen, and so to the præcordia, immediately after which the patient falls down convulsed throughout the whole body. If the patient, upon perceiving the disorder approaching at the toe, immediately makes a strict ligature under the knee, the fit will be put off. In such cases it has been necessary to apply a strong caustic to the whole part where the sensation first began, to burn down into the parts, and destroy the little nerve, which being affected so wonderfully disturbed the whole body. There is some appearance of this practice to be found in Celsus (g), where he says, *Quod si musculus læsus videbitur, præcidendus erit. Nam percussus mortiferus est: præcisus sanitatem recipit*: “ That if the muscle, or
 “ part injured be visible or accessible, it should be
 “ cut in sunder; for being punctured it is mortal, but
 “ admits of a cure when totally divided.”

That species of remedies which so obtund the *sensorium commune* by a narcotic force, as to remove the sense of pain, will also in some cases wonderfully appease those turbulent convulsive motions of the body here considered; and more especially they relieve hysterical convulsions. But we do not observe, that they were frequently used by the ancient Physicians for this purpose;

purpose; though Hippocrates, in the cure of a tetanus, recommends among other remedies, an infusion of henbane seeds in wine, with which an equal quantity of oil is to be afterwards mixed, and then the head and the whole body is to be anointed therewith while it is warm (*h*).

4. Hippocrates lays it down as a general rule in the cure of diseases. (*i*) *Quod morbis à plenitudine ortis mederetur evacuatio; illis vero, qui ab inanitione fierent, mederetur répletio*: “That such disorders as arise from plenitude are cured by evacuation; but those which arise from inanition, are cured by replenishing.” When therefore a profuse hæmorrhage has followed from a wound in some of the blood vessels, so as to diminish the just pressure required in the vessels of the encephalon, inanition is then the cause of the convulsions which thence follow; and which are therefore to be cured by repletion. The most famed antispasmodics, as *Sp. Corn. Cerv. Serici crudi, tinct. & ol. succin. Castor*, the agreeable aromatic distilled oils, &c. which in other cases so well appease these inordinate motions of the nervous system, are all of them here pernicious by their stimulus, which increasing the blood’s motion, would evacuate what little of the mass yet remained, through the wounded vessels, even ’till the patient expired. In this case the whole cure consists in replenishing the vessels, now empty and collapsed, from too great inanition, with new and good juices. But this is a task difficult enough to perform; since the ingesta or aliments require the conjunct action of the several viscera and vessels, with a previous mixture of a large quantity of healthy juices, in order to assimilate them into our own nature, and give them the qualities required in healthy animal juices, (*vide* §. 25. numb. 1). But after a considerable loss of blood, the quantity of healthy humours will

(*h*) Hippocrat. de intern. affection. cap. 54. Charter. Tom VII, pag. 678.
 (*i*) Aphor. 22. Sect. 2. Charter. Tom. IX. pag. 63.

will be diminished, which ought in a state of health to mix themselves with the small quantity of new or crude juices, and ascend together through the thoracic duct into the subclavian vein: and from the same cause too, all the viscera and vessels will be weakened in their actions; and from hence, the two powerful causes which convert the crude into healthy juices will be either destroyed, or at least greatly weakened. All therefore that can here be done to advantage, is to fill the patient with such liquid aliment, as most nearly approaches the nature of our healthy juices, which containing no stimulating acrimony, may be sustained by a weak body without detriment, and become assimilated by the remaining, though languid action of the vessels and viscera. All those aliments will be therefore serviceable here, which we recommended in §. 28. numb. 1; and among those, flesh broths more especially, in which the humours elaborated in a healthy animal body are dissolved in boiling water, particularly when a little citron juice is added to them, which prevents the too easy degenerating of these broths into a putrid state. For the same reason too, a little sorrel is frequently boiled in these broths, and rice, barley, oats, or the like mealy grain are often added. All these are to be given in small quantities, and often, to prevent the aliment from oppressing the weakened habit, and to make a gradual repletion of the vessels capable of supporting life, without hazarding a rupture of the lately conjoined vessels, which would be risked by too sudden a repletion of them, or too great a motion in the juices. It is scarce credible with how small a quantity of blood life may be sustained, if we were not convinced by most certain observation. A remarkable instance confirming this, was before alledged in the commentary to §. 161. And in women, who have been almost exhausted of blood in abortions, followed with convulsions, this method of repletion has been found to succeed happily; for when they have been almost given
up

up for dead, by thus gradually replenishing the vessels, they have been happily relieved from the jaws of death.

We have a remarkable observation given us by Lower (k), from whence it is evident, how much we may expect from flesh broths, in cases where a considerable quantity of blood has been lost. The account he says, he received from a Physician of indisputable credit: *Adolescenti sexdecim annos nato, cum magna sanguinis copia per biduum continuo erumperet, neque medicamentis, aut arte ulla cohiberi potuerit, jusculis eum recedere amici & adstantes curarunt, cumque ea valde avidè expeteret, atque assumeret, fluxus subinde concitior factus est, & tandem res eo devenit, ut, massa sanguinis fere tota effluxa, quidquid jam efflueret, dilutum & pallidum, sanguinis neque naturam, neque speciem præ se ferret, ipsi jusculo, quod toties hauserat, quam sanguini similis; atque eadem forma per diem unum aut alterum duravit hic aqueus stuxus, constante interim cordi motu suo, donec fluxu demum consopito, juvenis paulatim integræ sanitati restitutus est, & exinde in virum robustum & quadratum excrevit:* “ A youth of sixteen years old, having a continual hæmorrhage for two whole days together, which could be neither suppressed by any remedies nor other artifice; his friends and attendants took care to supply him with broths, for which he had a great liking, and taking them very greedily, the hæmorrhage was thereby sometimes increased, ’till at length, almost the whole mass of blood being evacuated; what was discharged appeared pale and dilute, having neither the nature nor appearance of blood, being more like the broth itself, which he had so frequently drank, than real blood: and in this manner did the aqueous flux continue for a day or two, the heart continually moving in the mean time, ’till the flux at length ceasing, the youth by degrees recovered his health entirely, and grew afterwards to be a strong and lusty man.”

5. We

(k) De corde, pag. 70, 71.

5. We have already explained the methods of suppressing hæmorrhage in wounds, in the numbers cited in this aphorism; and it is from thence evident, that many hæmorrhages may be artfully suppressed: But where the wounded vessel is inaccessible to the hand, as it must be when seated in the internal parts of the body, it will then be highly serviceable to apply ligatures so tight about the arms and thighs, as to compress the veins, and prevent the blood from easily returning thence to the heart: thus may the hæmorrhage be suppressed, at least for a time, and from thence the wounded vessels may perhaps, have opportunity to contract themselves and unite; and when the hæmorrhage is thus suppressed, the ligatures are not to be relaxed all at once, but gradually, a little at a time, to prevent the return of the malady. And thus there will be great hopes of a recovery, even in the most dangerous cases, provided life is supported in a low state, without any commotions either of body or mind.

S E C T. CCXXXV.

A Slight tumour and inflammation in a wound are good signs; but are bad if they increase too much: and therefore the use of baths, fomentations, anodynes, and antispasmodics, will be serviceable here, to be applied to all the parts injured: But of these we shall treat more largely in the history and cure of inflammation.

It was observed before in §. 158. numb. 5. that on the second or third day, after any considerable wound has been inflicted, there follows an increased heat, pain, redness, and tumour in the lips and bottom of the wound, and that all these are symptoms which constantly happen in wounds inflicted even on the most healthy person. Such a slight inflammation

therefore, with its attending small fever, is never a bad presage. For the dividing ends of the vessels contracting, resist the impulse of the juices, whence follows obstruction; and from the powers of life urging the juices with a greater impetus against the sides of the obstructed vessels, a slight inflammation and fever also attend, which are presently followed with a mild suppuration, casting off the ends of the obstructed vessels, together with their impervious juices, by that means restoring a free circulation of the humours through the whole surface of the wound, and thence a regeneration of the lost substances, and an union of the divided parts. This is also no less evident from the observations of Hippocrates, who strictly following the steps of nature, pronounces it a very bad sign when no tumour appears in great wounds; and in another place he commends loose tumours in wounds, but condemns hard tumours in them, the last being a sign the inflammation is too violent. The same thing is also well expressed by Celsus, when he says, (a) *Nimis vero intumescere vulnus, periculosum; nihil intumescere periculosissimum est. Illud indicium magnæ inflammationis, hoc, emortui corporis est, &c. At ne febris quidem terrere debet, si in magno vulnere, dum inflammatio est, permanet. Illa perniciosa est, quæ vel levi vulnere supervenit, vel ultra tempus inflammationis durat, vel delirium movet, &c.* “For a wound to swell too much
 “ is indeed dangerous; but it is the most dangerous
 “ for it not to swell at all: for the first denotes a great
 “ inflammation; but the latter is a sign the parts are
 “ about to mortify, &c. Nor ought any alarm to be
 “ taken from the fever which accompanies the in-
 “ flammation in a large wound; but that fever is bad
 “ which follows a slight wound, or which continues
 “ longer than the inflammation, or which excites
 “ a delirium, &c. But where a violent obstruction
 is formed in the vessels about the wound, and the
 juices move so fast as to excite a fever, with pain, tu-
 mour,

(a) A. Corn. Cels. Medic. Lib. V. cap. 26. pag. 295, 296.

mour, redness, and very intense heat in the part we may then easily perceive that the inflammation is much more intense than is required, from the observation of the common symptoms in every wound. If therefore such an inflammation was to continue, would corrupt or destroy the parts with a gangrene, or at least the consequent suppuration would be more profuse, to cast off the inflamed parts incapable of being restored; which parts cannot be separated from the rest of the living sound parts, without a considerable loss of substance, especially in the cellular membrane, in which is the principal seat of the suppuration: from hence will follow a delay in the consolidation of the wound, and a more unsightly cicatrix will be formed, and all the other maladies may follow which usually proceed from too great a loss of substance in the parts, from a violent suppuration. It is therefore necessary to remove the too great violence of the inflammation by proper remedies, to relax the vessels, attenuate the fluids, and remove their obstructing tenacity, which occasioned them to congregate. Hence baths, fomentations, and the like forms prepared of the most emollient herbs, are here extremely useful. But in the mean time, enquiry must be made whether the cause of the too great inflammation reside in the wound, or whether it comes from an inflammatory disposition in the blood, or from its increased motion by the fever: for in the first case a topical treatment will generally suffice; but in the last, it will be necessary to use general or universal remedies to quiet the increased motion of the blood, and to attenuate its inflammatory spissitude. But of these remedies we treated in some measure under the head of obstruction, and we shall hereafter consider them in the history and cure of inflammation.

S E C T. CCXXXVI.

IF blood escapes through a wound into any cavity of the body, it ought to be timely extracted, by placing the body in a convenient posture, and by sucking through a pipe, after it has been diluted, or else by dilating the mouth of the wound, or by making a new one.

There are hardly any empty cavities to be found in the body, except those destined to receive and accumulate the humours secreted from the blood: The whole cranium is exquisitely full, the cavity of the thorax and abdomen are also equally full; for wounds penetrating into those cavities, so as to make a free passage, let out their contained viscera, which are more or less pressed through the wound. But the blood discharged from the divided vessels may so compress the soft parts contained in those cavities, as to take up part of the space which those viscera naturally filled; and therefore the extravasated blood will injure the actions of those viscera, by compressing them; and acquiring afterwards an acrimony by putrifying, may corrode and destroy those soft parts which are in contact; and the same corrupt blood being attenuated by putrefaction, will be absorbed by the bibulous veins which open every where throughout the whole external and internal surface of the body, whence it may infect the whole mass of blood with a putrid quality, and thereby produce many bad symptoms. (a) Hippocrates declares, that blood preternaturally extravasated into the cavity of the abdomen, must necessarily corrupt or putrify, as we before observed in §. 172. numb. 1. And Galen, in his comment on that place, would have *οὐκ ἔστιν* to be understood any preternatural cavity; and at the same time puts us in mind, that by the word *suppu-*

(a) Aphorism. 20. Sect. 6. Charter. Tom. IX. pag. 259.

suppuration we may understand any other kind of corrupting or degenerating of the blood. But the word *ἐκπυρῆναι* may be very well understood to signify not suppuration properly, but that the extravasated blood preternaturally contained in the cavity, will make way for itself through the parts by suppuration, tho' the extravasated blood be not converted into matter properly so called.

Besides these larger cavities of the body, it is well known, that a cellular fat membrane is every where to be found under the skin, and betwixt the muscles which being easily dilatable, will yield to the impulse of the extravasated blood, and may by that means be frequently distended to an immense bulk, as we are taught by spurious aneurisms, and the blackness or livid colour of this part after violent contusions. Blood preternaturally residing in any of these cavities, may by its pressure, as well as corrupting, occasion many bad consequences; and therefore the indication directs to discharge it speedily, if it can be conveniently done. But it seems worth observation, that the extravasated blood may remain a long time without corrupting provided it has no commerce with the air; and it may be sometimes so attenuated afterwards by the use of diluent and resolving medicines, as to gradually disappear, by returning into the bibulous vessels. But more of this when we treat of contusions.

Whenever then extravasated blood is lodged in some cavity of the body, so as to injure the parts by its pressure, or to be in danger of corrupting, there being no probability of its being dispersed, the blood ought then to be extracted by art; and that either,

By the posture of the body.] This ought to be such, that the extravasated blood may by its own weight run out through the orifice of the wound. This may be much assisted by a knowledge of the posture in which the patient was when he received the wound; because in that posture the body ought to be placed as nearly as possible to discharge the blood,

therwise the membrana adiposa will frequently so intrude itself into the mouth of the wound, as to prevent any of the blood from being discharged. In the mean time, the orifice of the wound must be inclined as much as possible, that the blood may escape; as for example, if the extravasated blood be lodged in the cavity of the abdomen, it will be proper for the patient to lie in a prone posture. And Parey freed a wounded patient from danger of instant death, by discharging the blood lodged in the cavity of the thorax, by placing his head downwards, and his feet uppermost, as we before observed in §. 172. numb. 3.

[By sucking through a pipe.] This method is useful when the blood is extravasated into the cavity of the abdomen, but more especially when in the cavity of the thorax. In that case the surgeon takes a flexible pipe made of lead, leather, or whale-bone, having always an obtuse point to avoid injuring the parts; having introduced this into the cavity of the body, the extravasated blood is then extracted either by sucking, or by applying the syringe of an air-pump. But when the blood is lodged in the cells of the membrana adiposa under the skin, it is then evident, that this method will be of no use.

But neither will the position of the body, nor sucking through a pipe be sufficient to discharge the extravasated blood, unless it be fluid; for if it is already concreted into grumes, it ought then to be first diluted, to enable it to pass through the orifice of the wound or tube. For this purpose may be used a mixture of water with honey, and a small quantity of Venice soap, with the addition of a little wine and sea-salt: this liquor being injected warm, is by a gentle shaking, or by the motion of respiration, to be so agitated, as to mix with, dilute and dissolve, the congealed blood; and then by placing the body in a convenient posture, by sucking, the injected liquor is to be again discharged, and thus is the operation to be repeated, 'till the injection returns pure or untinged with blood.

Thus Parey, in the instance before alledged, extracted the remains of the grumous blood from the patient's thorax, by injecting a decoction of barley with honey and when, on the day following, he injected an infusion of centory, wormwood, and aloes, to more perfectly cleanse the parts, he was surprised to find that the wounded patient tasted, and was almost filled with the unpleasant bitterness of the injection. But it is evident, this method must not be used, so long as there is any danger of a fresh hæmorrhage.

By dilating the mouth of the wound, or by making a new one.] If the wound is too narrow, or if the panniculus adiposus is pressed into the mouth of the wound so as to obstruct its orifice, it must then be dilated or enlarged. It also sometimes happens, that the mouth of the wound is seated very high, while the extravasated blood being lodged much lower, cannot be discharged by the wound, without inverting the posture of the body, which the patient cannot well sustain for any time. Thus when a wound is inflicted on the upper part of the thorax, and the divided vessels extravasate a large quantity of blood in the cavity of the breast, where it will be accumulated chiefly in the back-part of the thorax, where the diaphragm descends deeply to enlarge the capacity of that venter, there will the blood lodge; nor can it be easily discharged thence by the mouth of the wound unless the patient was to stand on his head: and hence some rather chuse to contract the blood, by making a new aperture on the affected side, towards the lower and back-part of the thorax. The same is also true when blood is extravasated into the cavity of the abdomen, by a wound inflicted about the loins; here the blood by its weight will subside to the anterior and lower part of the abdomen, whence it may be much more easily discharged by making a paracentesis in that part, than it can be forced out of the mouth of the wound by pressure upon the abdomen, and by changing the posture of the body. It will be all

equally

equally necessary to make a new aperture to the wound, when the extravasated blood descends through the panniculus adiposus, and forms a point or tumour at the most declining part.

S E C T. CCXXXVII.

IF a wound descends betwixt the solid parts of the body, a way must be made to discharge its forces by pressure, by injections, by bandage, and by dilating the old, or by making a new wound.

Sometimes the wounding instrument is forced deeply betwixt the muscles, wounding the panniculus adiposus chiefly; and then the extravasated juices, and formed matter will enter into, and easily descend through the fat membrane, which has little resistance, and so increase the depth of the wound; because the juices cannot easily ascend, contrary to their weight, so as to be discharged by the orifice of the wound above. And frequently the retained matter burrows, or makes sinuous passages through the adipose membrane betwixt the muscles in an extraordinary manner, which afterwards creates the utmost difficulty in the cure. The best method of discovering this, is by injecting warm water with a syringe into the orifice of the wound; for the greater or less quantity of water received, will determine the length of the wound, and the largeness of its concealed cavity. But when the depth of the wound is searched for by the probe in a hasty manner, that instrument, penetrating the membrana adiposa, will form a new cavity, whence the cure of the wound will become more difficult. An instance of this kind we meet with in Hildanus (a), of a countryman, who in single combat received a wound with a sharp edged sword in the right hip,

Y 3

almost

(a) Observat. Chirurg. Centur. IV. Observ. 84. pag. 358.

almost over against the articulation : a barber-surgeon being called, upon introducing his probe, found that it had a passage upwards towards the os sacrum. But on the third day, when the patient was afflicted with intense pain, fever, inflammation, and other bad symptoms, Hildanus being called, found by his probe that the wound penetrated through the buttock towards the anus.

Now it is easily conceived, that a wound inflicted by a sharp sword, could not penetrate by the same thrust in two such very different directions, but that one of those passages must have been made by passing the probe. Hence it is evident, that an examination of wounds by introducing the probe, ought to be made with great prudence and gentleness ; the method of examining by injecting water with a syringe being much safer, provided this last be not made with violence : for even water itself may be so forcibly injected, as to lacerate the panniculus adiposus, and form extraordinary sinuses.

By pressure and bondage.] When it appears by a prudent injection of warm water, or a careful examination by the probe, how far the wound has penetrated, then a compress is placed over the sinus, and closely secured there by bandage ; and thus the retained humours are prevented from descending deeper into the cavity of the wound. In the subsequent dressings the compress is so approximated by each turn of the bandage, as to come gradually more and more close towards the mouth of the wound ascending upwards, and the mouth of the wound left open in the mean time, that the contained humours may have a free exit ; whence also, the bandage is so directed, as to press only upon the bottom or lower part of the wound, the mouth of which is left open continually, and not stopped with a tent. But of this method, and its good advantages, we shall say more hereafter, in treating on fistulæ.

By injections.] When the extravasated juices in the cavity of the wound are retained a long time, and not easily discharged, from the position of the mouth of the wound, by stagnation, and the warmth of the parts, they will be corrupted, and acquire a very malignant acrimony. Even the mildest or laudable matter will become thin, acrid, and ichorous, by being too long retained in the wound; and thereby the whole surface of the wound will become sordid and ill-conditioned: but so long as the surface of the wound remains foul or ill-conditioned, it can never heal or unite, even though the parts are retained together in contact by a suitable bandage and compressure. It is therefore first necessary to cleanse the wound with digestive remedies, as they are termed by the Surgeons: but then these remedies cannot penetrate into all the cavities of the wound, unless diluted first with liquor: and therefore what we recommended in §. 207. for cleansing foul wounds, are all serviceable here, being first diluted with water or some such vehicle, that they may penetrate through all the parts. Myrrh and aloes mixed with the yolk of an egg, with the addition of a little honey and sal ammoniacum, being afterwards diluted with water, are the chief for this purpose.

By dilating the mouth of the wound, or by making a new one.] After endeavours have been used for some days to cleanse the wound by pressure and bandage, with deterging interjections; if the condition of the wound does not alter for the better, this last method must be thought of. If the mouth of the wound is so narrow, as not to give sufficient exit to the matter formed in its cavity, it must be dilated; but if the mouth of the wound is so situated, that the confined matter can neither be discharged by its own weight, nor by changing the posture of the part, recourse must then be had to a new opening, by making which the confined matter may have a more ready discharge. But to do this, the mouth of the wound must be first closed with a tent, that none of the matter may escape,

escape, and then the humours will of themselves be accumulated at the bottom of the wound, and form a tumour there, which will point out the place where the new opening is to be made. The same may be also performed by injecting water with a syringe, so as to thrust out the bottom of the wound, as also by introducing the probe, and thrusting out the fundus of the wound with its apex, that the Surgeon may perceive the same with his finger; after which he may safely divide the integuments upon the apex of the probe, to make a new opening. But if the wound descends deeply betwixt the muscles or fleshy parts, so that the bottom of it does not come near the skin, but points inwards, it is then much more difficult to make a new opening to advantage; but the method which is best in that case, is to close the upper orifice of the wound, and to apply emollient cataplasms frequently to the bottom, that the external parts may the more easily yield to the matter, and point out the place where the opening may be most conveniently made.

S E C T. CCXXXVIII.

THE mouth of the wound is dilated and enlarged either by the knife, scraped lint, prepared sponge, gentian-root, or the like, which being inserted dry, with a string fastened to them, gradually swell and dilate by absorbing the humours.

The best of all methods for dilating wounds is by the knife. It is indeed true, that it excites a sharp pain for the present, while the parts are dividing, but then it ceases in a moment afterwards; whereas the other methods of dilating occasion a slow distraction, and a continual pain, while they confuse the margin of the wound at the same time; and then the confused parts

parts must be afterwards cast off by suppuration. So that those who reject the method of dilating by incision, to avoid the pain, generally expose themselves to greater torture and inconveniencies.

To dilate a wound without incision, the Surgeon introduces a dossil of scraped lint, or some other dry and bibulous substance, which is afterwards distended by absorbing the affluent humours, and by that means dilates the too narrow orifice of the wound. Nor is the force small which dry and bibulous bodies exert by moistening, to remove the contact of the parts betwixt which they are retained. For water is known by certain experiments to have this extraordinary property, of dilating the bodies into a greater bulk, into which it insinuates; and this it does so powerfully, that by this means only incredible weights are elevated, and the hardest stones are split asunder by very dry wedges of wood which are afterwards wetted; and in this manner the workmen separate those huge masses of stone from the rock, which are afterwards converted into millstones, &c. (a). Nor are we acquainted with the utmost extent of the immense power, which may thus be exerted; it is sufficient that it greatly surpasses the resistance of the obstacles. Scraped lint therefore being very dry, and formed into a tent, a piece of dry and fungous gentian-root, or a piece of compressed or prepared sponge being introduced into the mouth of the wound, are there retained either by a sticking plaster, or proper bandage, 'till they are considerably swelled by absorbing the affluent humours; and thus the whole force with which those bodies are distended, is returned on the parts in contact, and spent in dilating the wound. But amongst the substances used in this manner for dilating wounds, there is none which is compressed in so small a compass, and at the same time dilates into so large a bulk as sponge; which is therefore generally preferred before the rest, especially

(a) Acad. des Sciences, l'an. 1730. Mem. pag. 391. Boyle de Utilitate Philos. Experim. pag. 555.

especially when it is first prepared by art for this purpose. Some take a piece of sponge and tie it round with a very strong thread, after which it is introduced into the mouth of the wound, so that the knot of the thread may hang out, and be afterwards cut with a pair of scissars : but this is not practicable without much difficulty, and the following method of preparing it is much more preferable. They first melt resin and wax with a little oil, so as to reduce them to the consistence of a firm sticking plaster ; into this emplaster melted over the fire, they dip a large piece of very dry and clean sponge, so that it may be entered every where by the melted plaster ; this done, the sponge is next placed betwixt two warm iron-plates of a press, by which the imbibed plaster is forced out as much as possible, and the sponge is left in the press 'till all is cold, when it appears compressed in the smallest bulk ; and compact or firm like a piece of wood, capable of being cut into any shape. Thus that part of the emplaster which remains in the sponge after expression, will retain its dry parts very closely together, without hindering water, or watery juices, from gradually penetrating the bibulous sponge, so as at length to dilate it into its former dimensions. Since therefore the sponge is thus forcibly compressed into a very small compass, it is evident, that upon being introduced into the mouth of the wound, it will by degrees be distended by the affluent humours, 'till it acquires the greatest dimensions it is capable of ; whence it follows, that a very great dilatation may be made by this method. Also sponge thus prepared has this advantage, that it may be cut into small slips and portions of various figures, so as to enter even the smallest orifices of wounds and fistulæ, where scraped lint, gentian-root, or the like, are not capable of being applied.

But all these tents, whether of sponge or any other substance, are fastened to a thread, lest they should slip into the bottom or cavity of the wound, and there

create

create much mischief; and because without this precaution it is very troublesome to extract them.

Thus have we hitherto considered what relates to the history and cure of wounds in general, and also treated on those symptoms, which happening in wounds, do from their danger or malignancy require particular regard and treatment distinct from the disorder. It now remains for us to treat of wounds which occupy those parts of the body where the viscera are lodged; and in which many other indications are to be observed, besides those in common to all wounds. These considerations are generally disposed according to the order of the three great cavities or venters in the body, where all the noble organs are retained upon which the functions of life and health depend; and therefore writers in surgery generally treat of wounds in the head, thorax, and abdomen, distinct from each other. We shall therefore in the first place treat of wounds in the head.

Of Wounds in the HEAD.

S E C T. CCXXXIX.

WOUNDS of the head either injure only the external or common integuments; or else also the periosteum, cranium, dura mater, and pia mater, at the same time; or even the vessels, substance, cortex, medulla, and ventricles of the brain itself.

Wounds of the head are distinguished into such as injure the external parts, among which the bony skull is reckoned; and such as penetrate to the contents of the cranium: the external parts are again subdivided into the common integuments of the external parts of the body, and those proper to the head only. The common

common integuments are the cuticula, cutis, and *membrana adiposa*, which are found extended all over the whole surface of the body, but of a different thickness and disposition in different parts. The epidermis or cuticle on the back, or instep of the foot, very different from that on the heel; the skin itself generally much thicker on the back than on the abdomen; and the *panniculus adiposus* in the neck different from that in most other parts of the body. So also in the head, the skin is very thick, and furnished with large adipose cells; but the subjacent cellular membrane is thin enough, and hardly ever contains much fat: whence it appears evidently, that the same difference obtains even in the common integuments of the head. Besides these, there are also other integuments only proper to the head. For a tendinous expansion or aponeurosis invests the whole head under the cellular membrane, which being continued over the neck, descends almost to the shoulders: this aponeurosis is strongest in the upper part of the head, where it consists at least of two orders or strata of fibres mutually intersecting each other; which grow gradually thinner as they descend to the neck, which they cover, and at length disappear about the clavicles (*a*). Under this aponeurosis lies the *periosteum cranii*, consisting of two lamellæ closely united to each other: of which the interior lamella attached to the bone is by some called the *periosteum*; and the exterior lamella departing in some places from the interior one, as about the temporal muscles, is by many termed the *pericranium*. Under this *periosteum* lies the cranium itself, consisting of distinct bones, connected to each other with wonderful artifice, and composed of two bony tables or plates, containing the diploë betwixt them. To the internal surface of these bones is strictly connected a membrane, called the *dura mater*; and which is also termed the internal *periosteum* of the cranium: and under the *dura mater* place

(*a*) Winslow, *Exposit. Anatom.* pag. 659.

placed the pia mater, to which last adheres another very thin membrane called tunica arachnoides. Thro' the pia mater run all the arteries which pass to the brain, and all the veins which return from thence, both which sorts of blood-vessels are secured in their course by this membrane. And by these vessels the pia mater is immediately united to the cortical substance of the brain itself, from whence the medulla arises: which medulla being collected together in form of an arched roof, leaves cavities which are called the ventricles of the brain; in which ventricles is lodged an extraordinary congeries of blood-vessels, termed plexus choroideus.

Into all these parts may wounds inflicted in the head penetrate; and are always the more dangerous as they are deeper, and affect more of the parts before enumerated. Those wounds therefore of these parts will be of all the least dangerous, which only injure the common integuments; though even in these may sometimes arise very bad symptoms, as will be hereafter more evident.

In the first dressing therefore in all wounds in the head, careful enquiry ought to be made how far the wounding instrument has penetrated, and what parts it has injured; that one may be able to presage the maladies that are to be feared from thence, and endeavour to prevent them by the application of proper remedies. The signs by which he may know that only the common external integuments are injured, are exhibited in the following paragraph.

S E C T. CCXL.

THAT the external parts only are injured, may be known, 1. From the wounding cause or instrument, with its injurious figure; 2. From the smallness of its force; 3. From the condition of the parts wounded, especially with regard

regard to the figure of the wound ; 4. From the slightness of the symptoms ; 5. By inspection and lastly, 6. by the probe.

1. Thus if the integuments were divided with a knife, the wound may be pretty large, and yet not penetrated deep : but if the knife was thrust with the point foremost, it could not make a wound of any width, but it must penetrate deep. And thus also if the wound was inflicted by a crooked scymitar, it could not run to any great length, but it must also descend deep in the middle, as is very evident.

2. It is sufficiently evident, that the wounding instrument will penetrate less deep, as it is impelled with a less force ; which may be known from the relation of the patient, or others present.

3. The skull generally approaches a spheroidical shape ; and therefore a large wound cannot be inflicted on those parts where it has the greatest convexity, unless the wounding instrument was thrust deep ; as for example, about the anterior and most prominent part of the os frontis, and about the middle of the parietal bone on each side the skull ; but much less in that part where the os frontis meets the os sphænoïdes at the temples, where its surface forms an angular prominence. In other parts, where the skull has a more plain or flat surface, the inflicted wound may be of a considerable length without any great depth.

4. Those injuries of the functions which follow after the infliction of a wound are called its symptoms ; and the more numerous and malignant these last are, so much more reason have we to fear that a greater number of parts are injured, and those the more immediately necessary to life and health. But since in the head resides the source or spring of our animal actions, strict enquiry ought to be made, whether any of those actions have received any alteration since the wound was inflicted. A vertigo, noise in the ears, bilious

bilious vomits, sleepiness, or a deprivation or abolition
 of some, or all of the senses, &c. are therefore always
 of this import. If none of these appear, or if they are
 but slight and soon vanish, there is good reason to
 hope the wounding cause has not penetrated so very
 deep. Hippocrates carefully admonishes to make
 these enquiries, besides observing what comes within
 the limits of inspection. (a) *Etenim magis aut minus*
vulnerati hæc sunt indicia: si æger alto sopore detentus
uerit, aut tenebræ oculis offusæ, aut si vertigo prebende-
it, aut ipse conciderit: For, says he, the following
 are signs that the patient is wounded more or less
 deeply: the first, if he is seized with a deep sleep,
 or if a darkness is spread before his eyes, or if he
 is taken with a vertigo, or is not able to stand, but
 tumbles down." But it must be confessed that
 sometimes very deep wounds of the head, penetrating
 even into the substance of the brain, have not been
 immediately followed with such malignant symptoms
 as these. For in that remarkable case mentioned in
 117, the wounded patient found himself very well
 till the seventh day, though the iron point of the dart
 was lodged deeply within the brain, and was four
 months afterwards happily extracted; a compleat
 cure being thus made of so dangerous a wound.
 And therefore Hippocrates, and the most skilful Phy-
 sicians after him, more strongly suspect the danger of
 the wound when the malignant symptoms do not ap-
 pear in the beginning, but some days after the wound
 has been inflicted. Thus Hippocrates: (b) *Optimum*
videm esse, illum, qui vulnus in capite habet, non feбри-
tare, neque sanguinem ipsi erupisse, neque inflammatio-
em, neque simul ullum aliquem dolorem accessisse: si vero
quid horum apparuerit, securissimum est, ut in principio
pat, & pauco tempore permaneat, &c. At incipere fe-
brim in capitis vulnere quarta aut septima die, aut unde-
cima,

(a) Hippocrat. de capit. vulner. cap. 15. Charter. Tom. XII.
 pag. 121. (b) Hippoc. Prorrhet. Lib. II, cap. 15. Charter,
 Tom. VIII. pag. 818, 819.

cima, valde lethale est: “ It is one of the best sign
 “ for a person wounded in the head, to have no fe
 “ ver, no hæmorrhage nor inflammation, nor any
 “ kind of pain supervening: but if any of these ap
 “ pear, it is safest for them to happen in the begin
 “ ning, and to be of short duration, &c. But for
 “ fever to begin in these wounds on the fourth or
 “ seventh day, or on the eleventh, is fatal.” And
 hence Jacotius, in his learned commentaries on the
Prænotiones Coacæ, lays it down for a general rule, that
 the symptoms which appear soon after the infliction of
 a wound, are less to be feared than those which hap
 pen afterwards, or continue a long time; whether
 they are fevers or other symptoms. And therefore he
 advises the Physician to suspend his judgment, when
 the most severe symptoms appear in the beginning
 ’till it shall appear whether they continue or not (c). It
 is therefore evident, that an absolute or certain prog
 nosis cannot be deduced from the slightness or violence
 of the symptoms only, but that other circumstances
 are also necessary to be considered at the same time.
 one may, indeed, safely pronounce, that there is reason
 to fear the most dangerous consequences, when the
 most malignant symptoms appear soon after the acci
 dent; but yet one ought not to despair even in the
 most dangerous cases, nor yet be too rashly confident
 when there is no bad appearance in the beginning of
 the malady.

5. The condition of wounds in the head, when the
 external parts only are injured, is sufficiently apparen
 to the eye: and therefore, when the hair has been
 shaved off from the parts affected, and the blood
 washed away with some warm wine and water mixed
 in equal quantities, the first enquiry ought to be how
 far the wound has penetrated, and what parts it has
 injured; that from thence the prognosis and curative
 indications may be safely deduced. But among the
 signs

(c) Hippoc. Coacæ præfagia cum Interpretatione & Commentariis
 Jacobi Hollerii & Desiderii Jacotii, &c. pag. 9 4.

signs coming under one's inspection, and by which we learn whether the common integuments only, or the bone also is injured: Hippocrates (*d*) mentions one which ought to be regarded; namely, whether the hair, forced into the wound by the instrument, is cut in sunder or not: for if it appears to be divided, it may be then asserted that the bone is injured. For while the wounding instrument, though sharp, enters only the soft integuments of the head, the flexible hairs will follow the impression of the instrument without being divided; but when the hairs are pressed against the resisting bones of the skull, they can then yield no farther, but must be divided.

6. After gently dilating the lips of the wound, the surgeon then introduces a probe made of soft lead or pure silver, which last is very soft, flexible, and formed with an obtuse head or point: with this the depth and course of the wound is to be carefully examined with a light or suspended hand. For if the bone is laid bare in any part, the probe will sound against it; but if all the parts feel soft without any roughness or hard inequalities, and without any audible sound, we may be certain that the skull is neither laid bare nor injured under the parts wounded.

S E C T. CCXLI.

THESE wounds (240), though they may seem slight, are often dangerous, from their nearness to the muscles, tendons, futures, periosteum, cranium, nerves, vessels, and the brain itself; and also from the contractile power of the wounded parts.

Though from a skilful examination it shall appear that the external integuments only are injured, yet such a wound of the head ought not to be judged tri-

vial, since innumerable observations teach, that the slightest wounds in these parts have been attended with the worst events: and this not only in such cases where the contents of the cranium have been injured by a violent blow, &c. while the external parts seem scarce at all affected; but also in those cases where the internal parts of the head have received no damage, and the wound has reached no farther than the common integuments. Even these are dangerous.

From their nearness to muscles and tendons.] When bad symptoms frequently arise from injuries of the muscles and tendons, we have already observed in §. 163; but very strong muscles are inserted into the cranium, and especially about the occiput, where are fixed the splenii, cucullares, and other muscles. But also the large temporal muscles adhere to the cranium with a broad basis, and a tendinous expansion strongly invests the whole skull, as we observed in §. 239. When these parts are therefore wounded, very severe symptoms may follow, even though the periosteum and skull itself are not at all injured. Hippocrates (a) says: *Quibus tempora secantur convulsio in opposito sectioni partem contingit*: “That those who are wounded in the temples have a convulsion on the opposite side.” And in the place we before cited (§. 163.) from his Epidemics, a small and shallow wound inflicted near the neck with a sharp dart, killed the patient on the next day who was convulsed backwards.

Sutures.] It is by these that the bones of the skull are capable of growing and increasing, the equable figure of the cranium still remaining. These future sutures appear most conspicuous in young animals, and are continued as well in the internal concave surface, as the external or convex superficies of the cranium; but in old people, those indented sutures are no longer visible in the internal surface of the skull, and they either appear only as simple lines, or else are totally obliterated, at least are often so in very old people.

is observable, that the dura mater adheres very firmly to those parts of the cranium where the futures are, and sends out vessels there which unite with the pericranium, which last is also most firmly attached to the futures: and hence it is evident, that the disorder inflicted near the futures, in the parts withoutside the cranium, may be communicated to those parts contained within, by this continuity of their substance.

[Periosteum, cranium.] Which periosteum sends vessels to the bones of the cranium, and also receives vessels from those bones, whereby it is connected to them: so that the vital influx and efflux of the juices to and from the bones of the cranium, and especially their exterior table, depends on the sound state of the periosteum. This periosteum being therefore injured, will readily communicate the disorder to the bones of the cranium, and also to the dura mater, especially near the futures, where there is a manifest and reciprocal intercourse of vessels betwixt those two membranes, as we lately observed.

[Nerves.] Which arising from the nerves of the fifth pair, and from the portio dura of the seventh pair, are distributed in numerous and pretty considerable branches through the external parts of the head. These nerves therefore being punctured, or partially divided, all the bad consequences may be feared, which we enumerated before in §. 163, especially if we also consider that these nerves are held pretty tense, by their distribution through the integuments of the cranium, and that they are very near their origin.

[Vessels.] For there are pretty considerable arteries which run through these integuments, from whence a large hæmorrhage sometimes follows, after wounds in the parts.

[Brain itself.] For in some parts of the skull the bone is so thin, that you may see through it when cleansed; and therefore when the integuments of these parts are divided, there is danger, lest the nearly adjacent brain may be also injured. But this injury to

the brain may be derived, either from the wounded nerves, or from the continuity or communication betwixt the external and internal periosteum and dura mater; or, lastly, from the disorder which may invade the cranium itself, after being exposed by a wound in its integuments, and which may by degrees spread to the brain itself contained within the cranium.

From the contractile power of the wounded parts. It is a constant phaenomenon in all wounds, as we before observed, (in §. 158. numb. 1.) for the solid fibres and vessels divided, to gradually contract and recede from each other: but the divided parts thus contract more or less in proportion to their natural force and extension. The skin of the head is thick and strong, equally extended round the cranium, and very moveable, whence it will easily yield or give way: so that when the skin of the cranium is divided by a wound, it will soon contract and form a wide opening, from whence it is that such large scars remain, after the cure of the wounds inflicted on the forehead. If now some of the nerves in these parts are partially divided, and so forcibly distracted from each other by the contraction of the wounded integuments; all the symptoms following an injured nerve will be much more violent. Add to this, that the more the lips of the wound contract and open, the greater surface of the subjacent parts will be exposed to the injurious action of the cold air, from whence again many other bad consequences will follow.

S E C T. CCXLII.

AND this danger will be more especially when the wound is also accompanied with contusion.

If the wound is slight, but attended with contusion many bad consequences are to be thence feared: for

we say a part of the body is contused, when many of its small vessels have been broke or destroyed by the violent pressure of some obtuse instrument, and therefore contusion is always joined with a laceration of the vessels, an extravasation of their contained humours, and a consequent corruption of them, from their stagnation. But since the hard bones of the skull are placed beneath the integuments of the head, unless the wounding instrument was sharp, it must always occasion some degree of contusion; more, for this reason, in the head, than in other parts of the body. But since the skin of the head is very thick, and the subjacent panniculus adiposus very thin and easily distensible, being resisted beneath by the hard bones, it is evident, that the extravasated juices, corrupted by their stagnation, will easily make a passage through the non-resisting panniculus adiposus, and descend by their weight; and thus they may pass to the back-part of the head, and there irritate the large muscles which are inserted into the os occipitis, so as to excite malignant symptoms. In the same manner the corrupted juices may also descend to the temporal muscles, and to the forehead and eyes, and there produce the like bad consequences. But that the extravasated juices may thus easily pervade the cellular membrane, is evident from incontestible observation: for when a contusion in the vertex of the head has escaped unobserved, on the next day the forehead and eyelids themselves have been often found swelled and livid, from the extravasated blood filtrating through the cellular membrane to those parts. And therefore Hippocrates justly condemns wounds of the head inflicted by obtuse instruments; for, says he, (a) *Carnem enim contundunt, maturant, & lacerant. Et sub hujusmodi telis vulnera ad latera & in orbem aliquantulum cava & purulentia magis redduntur & humida, & longiori tempore repurgantur. Carnes enim contusas & laceras necesse*

Z 3

cessè

(a) Hippoc. de cap. vulner. cap. 14. Charter. Tom. XII. pag. 121.

cesse est in pus versas tabescere. “ They contuse, lacerate and corrupt the soft parts. And besides that wounds of this kind are rendered more purulent and moist, and are sinuous about the sides, and in some measure all round, and they take up more time in deterging and healing them. For contused and lacerated flesh must of necessity turn into matter, and be therefore consumed.” Another bad consequence to be feared from such wounds, is a contusion of the periosteum, or of the bone itself, or at least an injury of them from the extravasated humours from whence a caries of the bone, and its usual bad consequences may be expected. For a bone of the cranium may be contused, and at the same time seem to be in its natural state; and the contusion may extend more or less into the substance of the bone, tho’ the degree of injury cannot be judged of by the eye as Hippocrates himself prudently observes (*b*). From whence it is evident, how deservedly contused wounds of the head are suspected by prudent Surgeons; since the most malignant consequences may follow a long time after, when every thing is believed to be well. Among the many observations which confirm this we shall only alledge one instance which is cited by Bohnius from Paw (*c*). A certain person was by another drinking with him, struck with a pewter pot over the right parietal bone; nor could any fissure be perceived in the bone: he walked and was very well, ’til ten months afterwards he was taken with a vertigo in walking, and expired in a little time. After opening the cranium in the affected part, the bone and the dura mater were found perfectly rotten and foetid.

b Hippoc. de cap. vulner. cap. 7. Charter. Tom. IV. pag. 138

c De Renunciat. vulner. Sect. 2. cap. 1. pag. 136.

S E C T. CCXLIII.

AS also, if in a broad contusion, with a small wound or opening, there are fordes collected.

It frequently happens after a fall from a high place, or some such like violence made by an obtuse instrument, that but a small wound shall be inflicted in the skin of the head, though the adjacent parts are at the same time injured with a broad contusion. Both the wounded patient, and frequently the unskilful Surgeon, esteems such wounds of but little consequence; but they are afterwards surprized to meet with such malignant symptoms from so slight a wound: and no wonder, since the retained matter being unable to discharge itself by the too narrow aperture of the wound is thereby increased, and makes itself new passages through the cellular membrane, or else being corrupted by stagnation, the humours injure the neighbouring pericranium and muscles, &c.

I was some years ago called to a carpenter in a fever, who having none of the symptoms common to the epidemical one that then raged, nor being able to detect any cause of it after a careful examination, put me altogether at a stand; since there were symptoms enough to make it evident, that some malignant cause lay concealed. He had a considerable pain in his head, his forehead, eye-brows, and both eyes were swelled and looked red, and he complained of a tension in the nape of his neck, with his sleep much interrupted, &c. I asked him if his head had been hurt by any external cause, which he denied, even though I told him a second time, that I suspected some such thing. By good luck a servant standing by remembered, that eight days before a tile fell upon the patient's head, but from a small height; the pa-

patient said it was so, but that he had hardly any pain from it, and affirmed he did not perceive any uneasiness from it afterwards; so that he reluctantly permitted me to examine that part of his head. I found a little wound scarce bigger than a pin's head, but a contusion so broad, that it was an inch over. I ordered the integuments of the part affected to be immediately divided; on the next day the fever was much abated, and all the symptoms were much milder: the part was afterwards deterged by a mild supuration, and the patient thus cured without any worse accident.

S E C T. CCXLIV.

FOR confined matter (242, 243) occasions wonderful swellings, an erysipelas, œdema, pains, convulsions, a corruption of the bone and its periosteum, fevers, and even death itself. And the air rushing into the cavity of the wound, and being carelessly confined there by the application of emplasters, and compressed, forms surprising emphysemata or windy tumours.

Wonderful swellings.] When a great many of the small vessels are ruptured by a violent contusion, especially if the skin remains entire, or with but a very little wound, the extravasated humours being confined by the skin, extend the same to an immense degree; and that too, very suddenly: for the subjacent cranium cannot give way, and therefore the whole mass of extravasated humours distends and elevates the skin; and this is the reason why tumours from contusion seldom arise so large, or so suddenly in any part of the body, as about the head. I remember a maid servant, in the house where I lived, who falling down stairs, hit her forehead violently against the stone pavement; and

and in the instant of time that I came running to help her, there was a tumour formed upon her forehead as large as a hen's egg. It is also well known, that when children in play hit their heads against hard bodies, such tumours as these will speedily be formed. But concerning the extraordinary swelling of the parts from elastic air entering into the cellular membrane and being confined there, we shall treat presently.

Erysipelas.] Concerning an erysipelas, and its difference from a phlegmon, we shall speak hereafter in the history of inflammation, §. 380. It is sufficient here for us to remark, that by this name is understood a superficial inflammation, almost constantly restrained to the skin, (a) (*si exquisitum fuerit erysipelas, solius cutis est affectus*; "if an erysipelas is genuine, it affects the skin only,") of a reddish yellow colour; seated chiefly in the smaller vessels, which are less than those that carry blood: occurring in no part more frequently than in the head and face, and almost constantly denotes something malignant in injuries of the head. Hence Hippocrates (b) says, (*ab ossis denudatione erysipelas*) "that an erysipelas will arise from the denudation of a bone." And Galen, in his commentary on this place, observes, that *malum* is to be understood at the end of this aphorism; because an erysipelas does not always follow such a denudation of bones, but when it does follow such a denudation, it is always a *bad sign*, or symptom. It is also apparent from many places in Hippocrates, that by the word *ossis* (τῆ ὀστέου), he frequently understands the skull, as may appear from that passage, among many others, in the twenty-fourth aphorism of the seventh section. It is now easy to understand, that this disorder may arise in the skin of the head from a compression of the cutaneous vessels, by the extravasated and distending

(a) Galen. Method. Med. ad Glaucon. Lib. II. cap. 1. Charter. Tom. X. pag. 368, 369.

(b) Aphor. 19. Sect. 7. Charter. Tom. IX. pag. 301.

ing humours, or from their degenerating into an acrid state, so as to cause irritation.

Œdema.] Which in the general signification of the term, denotes any kind of tumour; but, more especially, such as are cold and soft, as we said before in the comment on §. 112. But here you are to understand by it, not a cold slowly forming tumour, but a very different kind of swelling from that, which is now very properly denominated, for distinction sake *œdema œdematodes*. But where such a white and pellucid tumour is formed, and also attended with great heat, it is then called *œdema erysipelatodes*, that here intended. Which tumour is formed when such small vessels are inflamed, as neither admit the red, nor the yellow ferous parts of the blood, but only the pellucid or lymphatic; of which we shall speak hereafter in §. 380. It has been also sometimes called *erysipelas bullatum*, because it greatly distends, or tumefies the parts which it invades, and especially the eye-brow and the whole face, when it is seated near the head. It arises from the same causes in wounds of the head, as an erysipelas does, and is generally esteemed a worse symptom.

Pains.] Because the confined matter which distends the skin will also distract its nerves; or else becoming acrid by stagnation, it may irritate and injure the very sensible pericranium, as also the adjacent tendons and muscles.

Convulsions.] Which may also arise from the same causes here as the pains; and more especially when the malady reaches to the internal parts lodged in the cranium.

A corruption of the bone and its periosteum, &c.] Under the cellular membrane lies the tendinous expansion mentioned in §. 239, and under that the pericranium, which immediately invests the skull, transmitting and receiving vessels into, and from the same. When therefore extravasated humours are confined under the tough skin of the head, the disorder there

formed is very easily communicated to the pericranium, but wherever this last is injured, the vital influx of humours to the bone is destroyed, and therefore the part of the skull which lies under the diseased pericranium will be carious, and must be afterwards separated before a cure can be performed; otherwise putrefying, it will corrupt the subjacent meninges and the brain itself, whence the most fatal consequences, fevers, and even death itself, often follow unexpectedly; of which we lately gave an instance in §. 242.

Air rushing into the cavity, &c.] The air presses on every thing on all sides; and therefore when a wound is inflicted on the head, so as to divide the skin, and penetrate the cellular membrane, and especially when a long enquiry has been made by the Surgeon with his probe thrust into the wound, to discover whether the periosteum, or skull itself, is injured, some of the air then enters this cellular membrane: If now the wound be closely covered with a sticking em- plaster, the received air is prevented from escaping, and being rarefied by the heat of the body, makes its way through the cellular membrane, and forms a tumour in the adjacent parts. The Surgeon perceiving this tumour, is generally more curious and active with his probe, to discover the cause of the latent malady; and thus air is again admitted into the dilated membrane, which covered up with a plaster, as before, the tumour is thus increased, and spreads itself farther, especially through the forehead, eye-lids, and face; hence the face sometimes makes a wonderful spectacle the next day, being all over distended with a pellucid, and elastic tumour, insomuch that the eyes are in a manner buried, and the projecting nose is scarce discernible. For it is remarkable, that the cellular membrane is more easily distended, as it is thinner and less replete with fat; whence it is that this membrane about the eye-lids is so easily inflated, and that about the scrotum and penis is so easily distended to an uncommon bulk in an anasarca; because in those parts the

the cellular membrane contains no thick fat, but if any thing a sort of mucilage; except in castrated animals in which a vast quantity of fat is accumulated in this membrane. Tumours, thus formed, are properly enough termed emphysemata, or inflations, which Gorraeus (c) defines to be a collection of a flatulent spirit, or air, in some void space of the body. (d) Galen also assigns pretty much the same meaning to this term when he says (ἰμφοσμήματα), *Inflationes ex flatuoso spiritu collecto nascuntur, alias sub cute, alias sub membranis ossa tegentibus, aut musculos viscerumve aliquot investientibus. Porro colligitur aliquando non parum etiom in ventriculo & intestinis, itemque medio spatii horum & peritonæi:* “ Windy swellings arise from: “ flatulent spirit, or air, collected sometimes under the “ skin, and sometimes under the membranes, which “ invest the bones, muscles, or some of the viscera “ It is also collected sometimes in no small quantity “ in the stomach and intestines, and sometimes in the “ intermediate space betwixt these and the peritonæum.” To distinguish these tumours from an œdema, he afterwards says, that if they are pressed with the fingers, they do not retain the impression, but found in some measure like a drum (e): but this is true only when the flatus is collected in the large cavity of the abdomen; for then upon striking it gives a sound like a drum; whence Physicians have called the disorder tympanites. But when this disorder is seated in the cellular membrane, the tumour may then give way to the pressure of the fingers, because the elastic flatus is by that means forced into the next adjacent cells of the membrane; and the tumour will again return when the pressure is removed. But as this membrane about the eye-lids is so easily tumefied from the great laxness and easy dilatability of its cells, therefore Ægineta defines an emphysema to be an œdematous tumour

(c) Definit. Medic. pag. 197.
Lib. XIV. cap. 7.
verse.

(d) Method. Medendi
(e) Lib. III. cap. 22. pag. 32

hour of the eye-lids. But in another place he repeats
 the same from Galen of an emphysema, which we just
 now quoted from him (*f*).

But how easily the air, which has once entered the
 cellular membrane, may penetrate into all its other
 parts, we are taught by the experiment of butchers,
 who having made a small wound in the skin of the
 slain animal, inflate this membrane with air, in order
 the more easily to free the skin from the subjacent
 flesh, without cutting either. It also appears from
 medical observations, that the air having entered the
 panniculus adiposus, may pervade almost all parts of
 the body, and produce wonderful tumours in several
 places, and sometimes swell almost the whole external
 surface throughout the body. A girl of about five
 years old being gradually wasted by a lingering disease,
 had a tumour formed in her knee about three days be-
 fore her death, which tumour, by degrees, occupied
 the whole body. When the tumour was pressed by the
 fingers the included air gave way with a kind of
 noise; and after perforating the skin of the abdomen
 with a knife after death, the whole tumour presently
 subsided, with the exhalation of an intolerable stench
 at the same time (*g*). Two wounds were inflicted on a
 stout young man, one near the right clavicle, and the
 other in the back near the left scapula: a tumour fol-
 lowed not only in the face, but throughout the whole
 body, which was puffed up like a sponge full of
 wind, wherever one touched it (*h*). And a like obser-
 vation we meet with in another place of the same au-
 thor (*i*). And the like tumours may possibly arise from
 putrefaction of the extravasated humours; since it
 is evident from experience, that putrefaction will pro-
 duce or extricate the elastic matter which lay concealed
 in bodies, and which, if it is not real air, has at least
 the

(*f*) Lib. IV. cap. 28. pag. 66, versa.
 sciences l'an. 1704. Mem. pag. 9,
 Histor. Anatom. rarior. Centur. V. Histor. 12.
 I. Histor. 89.

(*g*) Acad, des
 (*h*) Thom. Barthol.
 (*i*) Centur,

the same elastic power, by which it will expand greatly by heat. And thus drowned carcases, when they begin to putrefy, swell externally throughout their whole extent, and especially in the abdomen, by which means they emerge, from the increase of their bulk whereby they become specifically lighter than water. But since the extravasated humours, collected and confined under the tough skin, may thus degenerate by putrefaction; it is therefore evident, that it may also be sometimes the cause of this wonderful disorder. And possibly this might be the case in the instance of the girl lately mentioned, who dying of a lingering disorder, had the whole trunk of her body so much swelled a few days before death.

We have also an example of the same kind in Hildanus (*k*), where, after the most violent wounds of the head, the dead body smelt so bad, two days after the wounds inflicted, that hardly any body durst come near it; and the morning after, the head, face, arms and abdomen were tumefied in a frightful manner, and the scrotum was also inflated, so as to equal the size of a child's head.

But wherever such an emphysema is found, the curative indication directs to discharge the elastic matter from the cellular membrane which it distends. And this may be done by a moderate pressure, by frictions and by driving the included air towards the mouth of the wound, first dilated, when necessary; or by scarifications penetrating into the cellular membrane, to give a free exit. (*l*) Parey gives us a fair instance of the success of scarification in a case of this nature. A man had his throat cut with a sword, which divided part of the wind-pipe and one of the jugular veins from whence followed a profuse hæmorrhage, and a rattling from the passage of the air, through the wounded trachea: the lips of the wound were conjoined by nature, and astringent remedies were afterwards applied.

(*k*) Observ. Chirurg. Centur. II. Observ. 25.

(*l*) Lib. X. chap. 30. pag. 249.

plied. A little while after the dressing, the air insinuating into the cellular membrane, wonderfully distended not only the parts wounded, but also the whole body. The face was so inflated, that no appearance either of eyes or nose could be perceived. While the miserable patient was in this condition, given over by every one, a skilful Surgeon boldly perforated the skin with a great many very deep scarifications to make way for discharging the included air; and so happy was the success, that the wounded patient was entirely restored to his former health, and thus in a manner snatched from the jaws of death.

But these emphysemata more frequently accompany wounds of the breast, which penetrate into the cavity of the thorax; because the air which entered by the wound into that cavity, cannot often easily escape again, the wound being either too narrow, or closed by some means; from whence the air, rarefied by the heat of the vital viscera, endeavours to make a passage into the cellular membrane. But if the lungs, being also injured at the same time, shall emit air into the cavity of the thorax, it is then evident, that frightful emphysemata may be formed, more air being accumulated in every respiration.

S E C T. CCXLV.

IF then the integuments only are injured, without any of the other accidents (in 241 to 245), the cure is then easily performed by a proper bandage, and the treatment before described (in 185 to 239); and this, notwithstanding the wound may make a formidable appearance: But it is more especially serviceable in the beginning of the cure, to make an exact closure of the wounded lips while bleeding, and make the dressings seldom, and very expeditiously, carefully defending the

the parts in the mean time from every thing too moist, oily, or relaxing, and also from the air itself.

When the common integuments only appear to be injured, without any other malignant symptoms, to make one fear that some bad accident may lie concealed within, none of those symptoms being observable, which were enumerated in the aphorisms here cited, an easy cure may be then expected; but it is evident, from what has been said before, that wounds of the head, even such as appear very slight, ought never to be thought trivial, since they have sometime had a most fatal issue; yet when the common integuments of the head only are injured, though the wound be considerably large, it is generally very easy to make a speedy cure; because the largeness of the wound very seldom or never offends in this respect: but on the contrary, the smallest wounds, for the reason mentioned at §. 243, are often attended with the most danger, which may be avoided, especially by dilating the too small opening of the wound.

What obtains in all wounds, will also take place more especially in wounds of the head, injuring the common integuments only; namely, to heal them more readily, as they are more recent and yet bleeding: for then is the properest time to dispose the divided parts in the best manner for uniting with each other, by bringing them into contact; as we observe in the cure of wounds in general; all which is applicable to these wounds. But there are still some particular observations to be made, peculiar to wounds of the head, even such as affect the common integuments only.

The bandage serving to retain the apparatus or dressings, or to approximate the divided parts to each other, ought to be moderate, so as to make but a gentle pressure; for if the bandage is drawn too tight,

will forcibly compress the integuments against the hard adjacent skull, whence a compressure of the vessels, inflammation, and all the bad consequences that may from thence follow. Skilful Surgeons always use a soft and easy bandage in these cases. But the divided lips may be united not only by compress and bandage, but even more easily by sticking plasters, or the dry suture, as it is called; because these wounds divide little more than the skin, and the subjacent cellular membrane being thin, easily follows the skin to which it is connected.

To dress seldom and expeditiously.] Thus skilful surgeons seem to do hardly any thing in these wounds, while they prudently avoid by that means a great number of bad symptoms, which the more ignorant bring on, and which afterwards often require the greatest art to remove. For the whole intention here is to re-unite the divided integuments as soon as possible: and this, as we often observed in speaking on the cure of wounds in general, is done by self-sufficiency of nature only; art barely removing the impediments, and assisting her action. When all the signs therefore denote that the cure goes on well, of what service will it be to frequently undress the wound, and expose the tender growing vessels to the injurious contact of the air? And besides, that vain shew of diligence, by frequent cleansing or wiping the wound with lint, abrades what last grew up. It will be therefore sufficient to dress the wound seldom. For if any thing is amiss, or if there is so much matter as requires to be cleansed, it may be perceived by the heat and slight itching that will invade the parts: and the smell will easily discover, whether any thing of putrefaction is confined; or if any malignant symptom arises, it will indicate what more is to be feared and done. Cæsar Magatus (*a*), who has evidently demonstrated

(*a*) Cæsar Magati de rara medicat. vulner. Lib. II. cap. 26. pag. 9, &c.

monstrated by solid arguments, as well from reason as experience, how useful it is to dress wounds but seldom, tells us, in treating on simple wounds of the head, without any exposure of the bone, that when the lips of the wound are confined and dressed with little olibanum, mastic, and sarcocol, he would not have the dressings removed within four days time, for then an union of them will be formed; but when there is a loss of substance, or the gaping of the divided lips requires an incarnation of the lost substance he would then have the renewal of the dressings deferred 'till the seventh day. The Surgeon may indeed come every day or oftener to visit the patient, and enquire whether he perceives any pain, itching, great heat &c. and may readily smell whether there be any part putrified, and if he observes neither of these, it will be best to let the apparatus of dressings remain. But if he find it necessary to renew the dressings, he should do it expeditiously, and have every thing first in readiness for application, before he exposes the wounds. But to frequently undress and wipe wounds of the integuments and other parts of the body, does little more damage to them than that of retarding their cure; but in the head, where the disorder of the integuments is so easily communicated to the subjacent pericranium and the skull itself, much more dangerous consequences may arise, whence it seems that the seldom dressing of wounds in the head cannot be too well inculcated. In fractures of the bones, with wound of the soft incumbent parts, after a reduction of the bones, the apparatus of dressings has been often left on for whole weeks together; and yet the wound accompanying the fracture has been happily cured notwithstanding it was not cleansed as usual by art.

Too moist, oily, or relaxing, &c.] The cellular membrane under the skin of the head is very thin, and easily dilatable, and naturally confined betwixt the said skin and the hard resisting skull; so that whenever moistening or relaxing remedies are applied to these wounds

the integuments, the cellular membrane thus moistened will swell, and be filled with foreign juices, hence it will degenerate into a fungous substance, which must be afterwards cast off by suppuration, which, when large, or of long continuance, generally injures the subjacent pericranium. And therefore the use of such remedies in wounds of the head, is condemned by the general consent of all skilful Surgeons, after Hippocrates (b), who says, *Capitis vulnus nullus re-alefaciendum, ac ne vino quidem, aut quam minimum: neque cataplasmata, &c. postulat*: "That a wound of the head does not require to be moistened with any thing, even not so much as with wine, or at least with a very little; nor with cataplasms, &c." And in the same book he afterwards adds, (c) *Malum est, humidam in vulnere (capitis) carnem esse, & nimia uligine fluentem* (ἡ μὲν δὲ σαρὶς) *idque longo tempore repurgari*: It is a bad symptom for a wound in the head to contain moist flesh, or too great a flow of moisture, as also to be a long time in cleansing." And after he has observed that the cut and contused flesh ought to be separated by turning into matter, he says, that the wound should be brought to suppuration as soon as possible; but when it is once deterged it ought to become drier, and thus it will very speedily heal, and fill up not with moist but with dry flesh, &c. Whenever therefore a contusion being joined with a wound of the head requires the use of fomentations, the modern Surgeons always use wine, lest a liquor altogether watery should too much relax the parts. For the same reason too all oily or fat substances are to be avoided in wounds of the head, since they offend not only by over-relaxing, but also by their rancour and tenacity, eroding and obstructing the small vessels, and rendering them not perspirable. Wounds of the head have been observed very difficult of cure in Italy (d),

A a 2

and

(b) Hippoc. de Capit. vulner. cap. 17. Charter. Tom. XII. pag. 2.

(c) Capit. XXVI. ibid. pag. 125, 126.

(d) Lud. Dureti comment. in Coac. Hippoc. pag. 429.

and especially among the Florentines, which they ascribe to some latent quality of the air; but it is a common observation of several authors, that they apply *oleum rosaceum omphacinum* to these wounds, and they also anoint the adjacent parts, with the same oil (e) And from hence it has been observed, that none at all, or but very few patients escape, even though they were but slightly wounded: and therefore (f) Severinus exclaims against the fatal use of oil, which was commonly used by the Neapolitans in wounds of the head and says, that it occasions even the slightest wounds of the head to turn out bad beyond all expectation, in so much that hardly one in a hundred escapes; whereas the Malta Physicians so successfully used oil when mixed with wine, that out of a hundred patients wounded, scarce one was lost; the tenacity of the oil being broken by the addition of wine.

And from the air itself.] Which is not always to be avoided on the account of any malignant matter lodged in itself, but because it chills the tender vessels by its too intense cold, or else by being over moist relaxes them, so that they form a fungus. Yet the air of hospitals, where a great number are confined to their beds in the same place, may be pernicious to wounds, by being replete with the putrid exhalations. The seldom undressing of wounds is also recommended on this account of the air; and when the dressings are applied to wounds of the head, should be done in an air that is of dry or warm temperature, which if not naturally so, may be procured by fire and the burning of spices, amber, mastich, olibanum, &c. But more on this Subject may be seen in the comment on §. 200.

(e) Bonet. Anatom. practic. Tom. III. pag. 341.

(f) M. Aurelii Severini trimemb. Chirurg. pag. 210.

S E C T. CCXLVI.

BUT if the wound is attended with the symptoms before described (241), then various remedies are to be used (185 to 239), according to the different nature of the wound, and the parts affected (241).

In aphorism 241, those parts were enumerated, whose vicinity made them in danger of being injured by visible and otherwise slight wounds in the head. It will now therefore readily appear, that nothing can be in general determined with respect to the cure of such accidents, as may arise from the wound as a cause, before the nature of the parts adjacent to the wound is likewise understood; and that after this, it must be determined what injury is threatened to the part from the wound, before any thing certain can be concluded towards the cure, or prevention of the accidents. For division of the arteries, which are frequently considerable in these parts; will require a very different treatment from the division of a tendon or aponeurosis, since the latter is attended with more malignant symptoms: but concerning what must be observed in the treatment of wounds, according to the different nature of the several parts injured, we have already spoke under the cure of wounds in general, from 185 to 239.

S E C T. CCXLVII.

THE contused parts here (242) are to be well digested off, by the use of such remedies as are able either to discuss or suppurate, provided always that you chuse such as are not injurious to the nerves and membranes

358 Of Wounds in the HEAD. Sect. 247
(204, 207, 245); otherwise the contused parts
are to be cut out.

A contusion supposes a rupture of many vessels and an extravasation of their humours, which being afterwards collected in the cellular membrane, often occasion very surprising swellings; and unless the wounding instrument was very sharp, wounds of the head are almost constantly attended with some degree of contusion. It is therefore necessary here for the extravasated juices to be either discharged, or else disposed to be absorbed again by the vessels; and the ruptured vessels are to be restored to their former continuity. If now the contusion is slight, and the extravasated humours are still pervious, they may be then safely dispersed; which may be happily procured by fomenting the parts with such remedies as dilute and attenuate the animal juices, and at the same time prevent their putrefaction, without over-relaxing the solids. The urine of a healthy man, with the addition of a little sea-salt or sal ammoniacum, and some wine, composes an admirable remedy for this purpose with which the tumours arising from contusions in the heads of children, are very frequently and successfully dispersed. The like fomentations are also prepared from rue, scordium, and the like plants, which have a particular antiseptic quality, and prevent putrefaction at the same time that they powerfully attenuate or dissolve such juices as are concremented. Nor are slight contusions only capable of being thus remedied, but also very large tumours have been by these happily dispersed, when it was thought impossible to cure them but by incision. A woman in running fell down and hit her forehead against the hard frozen ground, so that a large swelling was instantly formed. The Surgeon being informed that the woman vomited several times, thought that the cranium had been depressed and was for having the integuments laid open by a crucial incision: but the celebrated Ruysch being called

ed into consultation, would not have the incision made, but applied woollen cloths dipt in a warm fomentation, prepared from the 'foresaid cephalic herbs boiled in wine, and this with so much success, that the tumour lessened in three days time, and soon after wholly disappeared without leaving any bad symptom behind. And he adds, that this treatment he had often experienced useful in cases where the integuments of the head were going to be laid open by incision (a).

But when this dispersion of the contused parts has been attempted without effect, or if the violence of the contusion is such, as to leave no hopes of a discussion, the only method that then remains is to separate the corrupted parts by a gentle suppuration. But this operation of converting the irresolvable juice into laudable matter, is by the Surgeons termed digestion, as those remedies which reduce the extravasated and impervious juices to the condition of laudable matter, are termed digestives; concerning which we treated in the comment on §. 207. But in wounds of the head, care must be taken not to use such of them as are too emollient or relaxing; and therefore cataplasms must not be here used, because they are too moistening: but let some pure turpentine, or some such other native balsam be dissolved in the yolk of an egg, to break its oily tenacity, and afterwards add some *Ung. Basilici, Aurei, &c.* then sprinkle in some very fine powder of myrrh, aloes, olibanum, &c. and thus will be formed a digestive medicine, which also at the same time powerfully resists putrefaction, and which has been always found amicable to the nerves, membranes, tendons, and nervous or tendinous parts: a little of this digestive being spread on a pledget, is to be imposed on the affected parts, and there secured by an aromatic emplaster, which will warm the parts, and by its gentle stimulus increase the motion of their fluids, which is always serviceable in forwarding a digestion.

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(a) Fred. Ruysch observat. Anatom. Chir. Centur. obs. 80.

gestion. Over all these, again apply some woollen cloths, moistened with some discutient and penetrating fomentation, which also resists putrefaction, being careful to apply them as hot as the patient can bear, and to prevent their too speedy cooling. Forms of all these medicines are given in our professor's *Materia Medica*, and which ought to be varied according to the several seasons of the year, and the different condition of the wound.

But when the extravasated juices have entered the cellular membrane, and considerably distended it, so as to form a large tumour, the circulation is thus often suppressed, and the said membrane becoming in a manner gangrenous separates from the other parts, together with its inflating juices: and in this case it may be safely cut out. We also see that the cellular membrane may be surprizingly distended in other parts of the body: thus, for example, in the back of the hand there is scarce any fat, but the tendons of the muscles are included in the thin cellular membrane, and yet a tumour is often formed there by inflammation, so as to rise two inches above the surface of the skin, all which swelling is seated in the thin cellular membrane: the circulation in it is then suppressed, and upon opening the tumour, large portions of the gangrenous membrane appear, which are safely extirpated. The same practice may also take place in wounds of the head, when the cellular membrane is in like manner corrupted and separated, with its extravasated juices, from the adjacent parts. But you are not to understand here, that the skin is also to be cut off, with the contused parts which cannot be brought to suppuration; for it would be highly pernicious to lay bare the pericranium of so much of its integuments by a large and severe incision, especially as they with difficulty grow up again, and always remain weaker than the rest, to the great detriment of the patient. Hence Galen (*b*) diligently advises always to preserve the skin

(*b*) Comment. 3. in Hippocr. de Fracturis, Charter. Tom. XII. p. 254.

as much as possible, in every wound or ulcer; for says he, *Nuda enim caro, si sine cute relinquatur, ægre ad cicatricem perducitur*; "the naked flesh, if left without the skin, is very difficultly brought to cicatrise." Of this, I remember to have seen a lamentable instance. A healthy and middle aged man had a broad wart on the lower part of one side of his forehead, near the temple; after the fruitless trial of various remedies, the Surgeon, in other respects skilful, cut out the wart, together with all the adhering skin, which could not by any means be brought to cicatrise, but the place continued naked, and the circumjacent skin gradually contracting more and more, exposed a greater surface of the parts, from whence arose a malignant and eating ulcer, which destroyed the unhappy patient. Nor is this surprising, since the pericranium only, incumbent on the naked bone, does not appear capable of regenerating the lost substance. Therefore what we have here said is to be understood of the cellular membrane inflated and corrupted, which may be then safely extirpated.

S E C T. CCXLVIII.

IF there is any collection of matter (244), the wound is to be dilated by incision; and it will be also necessary to deterge or cleanse the parts, (238, 207, 208.)

For the whole malignity of such a wound will arise from the extravasated humours being confined by the thick skin of the head, and not being capable of discharging itself by the too narrow orifice of the wound, which will occasion it to make a way into the cellular membrane; or else by stagnating and corrupting, it may effect the pericranium and bones of the skull itself. A dilatation of the wound will therefore give a vent to the extravasated and confined humours, and

at the same time make way for the application of proper deterging medicines. That the humours are thus confined, may be known from the narrowness of the mouth of the wound, and from the looseness and tumour of the adjacent integuments, and especially if the wounded patient has a fever, for which no other visible cause can be found.

Nor is there any danger here of hurting the tendinous expansions, because the whole tumour is seated in the cellular membrane, which may be very safely incised together with the skin: even we are taught by innumerable observations, that not only the skin but all the integuments may be safely divided quite down to the bone, when necessary.

Hippocrates reckoning up the wounds of the head which require incision, includes among them those. *Quæ non satis idoneam habent longitudinem & latitudinem, qua perspicui possit, numquid os a telo male affectum fuerit, &c. & ubi vulnera obliquam quandam cavitatem habent, cavum illud late incidere oportet, &c. & ubi vulnera orbiculata & admodum cava fuerint, ejusmodi quoque incidere oportet, ut circulari plaga in longum bifariam divisa vulnus longum efficiatur (a):* Which have
 “ not a sufficient length and width to admit of seeing
 “ whether or no the bone has been injured by the
 “ instrument, &c. And when the wounds have an
 “ oblique cavity, that cavity ought to be largely incised,
 “ &c. And when wounds are round and very
 “ hollow, they ought also to be incised in the same
 “ manner, that the circular wound being slit open
 “ longitudinally may make a long wound.”

How much the symptoms may be relieved by a timely incision in this case, may appear from the instance alledged in §. 243. But after the wound is dilated it may then be dressed with the digestive we recommended under the last aphorism; and concerning the depuration of wounds we treated in §. 207, 208

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(a) Hippocrat. de vulner. capit. cap. 18, Charter. Tom. XII pag. 123.

But that dilatation only is proper here which is made by the knife; because that made by the swelling of sponge or the like, (§. 238,) is generally pernicious, by obstructing the mouth of the wound for some hours, so that nothing can be discharged, whence an emphysema and other tumours are frequently formed. Add to this, that they increase the contusion and inflammation in the lips of the wound, which will require the suppuration to be continued longer before the wound can be healed.

S E C T. CCXLIX.

IF the pericranium be injured, so as to expose the bone naked for a long time, or to make it foul, the vessels of the periosteum, and consequently of the bone itself, will be thus destroyed; and their contained juices stagnating and putrifying, will separate a lamella from the bone, which will at length exfoliate, or cast off a yellow, brown, or black scale.

After having treated of such wounds in the head as injure the common integuments only, it now follows that we examine the symptoms which arise from wounds injuring the pericranium also. As all the other bones throughout the whole body are closely invested with a periosteum or peculiar membrane, so the bones of the skull are also covered with a similar membrane termed pericranium. The anatomical injections of Ruyfch (*b*) demonstrate, that an infinite number of vessels are spread through this membrane, which send off branches that are inserted into the adjacent bone, which they furnish with the juices necessary to life and nutrition. By the insertion of these vessels it is, that the pericranium strongly adheres to the skull; so that if this membrane be stripped from
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the adjacent bone in a living animal, it appears full of red points, from the division of those vessels. The pericranium cannot therefore be injured without destroying a great number of these vessels which it sends to the bone. But the extremities of the ruptured vessels discovered on the surface of the bone, may again renew the like plexus or membrane in the same place, where the pericranium was separated from the skull; and this by the same means that all other losses of substance in wounds are repaired, as we observed before in §. 158. numb. 10, and in §. 190, 191. But when the bone has lain naked a considerable time, and especially if it has been freely exposed to the air, the tender extremities of those vessels will by that means be destroyed, and rendered wholly unapt to produce the like membranous intertexture as was destroyed. The exterior surface therefore of this bone, deprived of its influx of vital juices, will mortify, nor will it ever grow again to the living parts: and hence nature endeavours to cast off or separate the dead lamella, by the action of the living vessels and fibres next beneath it; and this dead scale being separated, a new pericranium grows again out of the bone, and from the circumjacent sound pericranium. It is a sign that the bone is thus affected if it changes its colour, which in sound bones is inclining to red, or in some places of a whitish blue; but the bone affected turns yellow, and grows gradually darker, degenerating into a brown, and at last into a black colour, under which last the foul bone exfoliates or casts off the dead scale. The more the bone changes from its natural colour towards a black, the more it tends to corruption, as is very apparent in the teeth, which when beginning to decay from any cause, lose their whitish blue or pearl colour, and turn from a white to yellow; so through various degrees of brown to black, and then fall to pieces. It appears from the most accurate observations, that the bones composing the skull were originally in the foetus no more than cartila-

cartilaginous membranes, in the midst of which is begun the first rudiments of each bone, from the center of which, bony striæ or rays are detached all round: and thus is produced, first that internal plate of the skull which is termed vitreous. Afterwards those radii of bone, or the reticular fibres of them, grow gradually broader on their outside, and send out perpendicular leaves, of different sizes, figures, and positions; and from these arises the diploë of the cranium. Then the points of these bony plates or wedges which compose the diploë, being in a manner flattened or beat down, and spread abroad, they run together like scales one over another, and make up one uneven lamella, which constitutes the outermost table of the skull. The two tables of the skull thus formed, grow afterwards more thick and compact; for both the long radii and the perpendicular wedges become thicker, and receive an addition of new matter. From this formation of the bones of the skull, deduced not from hypothesis but from nature herself, (as described by the celebrated Albinus (*c*), whom I think it a great happiness to have had for my teacher in anatomy, and shall always gratefully acknowledge) it is evident, that the parietal, occipital, frontal, and temporal bones of the skull, are made up of lamellæ or thin plates, which may be more especially injured in wounds of the head; so that a disease in the wounded pericranium, may be communicated to the outermost lamellæ of the subjacent bone, and may also more or less injure the interior lamella. It also seems very probable, that the vessels run betwixt each lamella, at least in the younger age, when the bones have not yet acquired their greatest solidity; though they may be afterwards gradually obliterated as age advances, like a great many more of the vessels in the body. This is also confirmed by some observations, where the constituent parts of the bone being preternaturally enlarged

(*c*) Bernard. Siegfried. Albini, &c. *Icones Ossium fœtus*, &c. pag. 6, 7.

larged beyond their usual dimensions, have exhibited such a soft pulp or intertexture of vessels. For the bones of the skull in an infant three or four years old, were almost in every part seven or eight lines thick; they were soft, and, upon being pressed, discharged a considerable quantity of blood and lymph; and they also contained very conspicuous blood vessels (*d*). The same thing seems also to have been observed by Hippocrates (*e*), when he says. *Ac totum capitis os, excepta parte infima atque suprema admodum exigua, spongiæ simile est. Et habet os in se multas carnes humidæ similes, quas si quis digitis conterat, ex ipsis sanguis prodit. Insunt quoque in osse venulæ tenues cavæ sanguine plenæ:* “ That the whole skull, except the outer and inner “ surface of it, which make but a small part, is like “ a sponge. The bone also contains in it a good deal “ of substance like soft flesh, which if one presses with “ their fingers, blood issues from it. There are also “ small vessels within the bone, which are hollow, “ and full of blood.” The bony lamella therefore, whose vital influx of juices is destroyed, will be separated by the force of the vessels running betwixt that and the next subjacent sound lamella; or even if these vessels are obliterated by the closer approximation of the lamellæ, those vessels which run with the diploë will be able to produce the same effect. Hence perhaps it is, that the bony lamellæ corrupted are more difficultly separated in old people; and from hence too may be deduced the usefulness of the method we shall describe in §. 252.

But though one ought generally to expect an exfoliation of the bone, when it has been laid bare from the pericranium, and changes its colour, yet we find that sometimes by accident, though perhaps very rarely, the cure may be compleated without, as in the case of Ruyfch (*f*), who tells us, *Vir ab equo in capite percussus,*

(*d*) Acad. des Sciences l'an. 1734. Histor. pag. 60.

(*e*) Hippoc. de capit. vulner. cap. 2. Charter. Tom. XII. pag. 116.

(*f*) Fred. Ruyfch, Observ. Anatom. Chirurg. Centur. Observ. V.

is, in terram tanquam mortuus cecidit, cum tanta altius ossis syncipitis denudatione, ut imperialis tegendo vix sufficeret. Hæc ossis denudatio in totum nigricabat, circulo excepto, qui cuti proximus straminis latitudinem obadebat. Hoc circulo albo de die in diem diminuto, pasciens convaleuit, sine ulla visibili ossis separatione, aut raspatorii usu, &c. “ That a man being kicked on the head by a horse, fell down on the ground as one dead, having so large a part of one of the parietal bones laid bare, that a half crown would scarce cover it. The whole face of the uncovered bone turned black, except the margin of it next the skin, for about the breadth of a straw, which was white. This white circle lessening from day to day, the patient was cured without any visible separation of the bone, or any use of the raspatory.” But perhaps in this case a thin exfoliation might have been made, not all at once, but in little particles, separated at different times, and discharged with the matter unperceived.

S E C T. CCL.

THE cause of which (149) is not any malignity in the air, with which it is falsely accused; but a rupture of the continuity of the vessels, or the coldness of the air contracting the vessels, and drying their extremities in the bone.

In the history of wounds in general (§. 149.) it was affirmed, that a wound injured those actions which depend on the continuity of the parts divided, and the determinate course of the juices through the vessels: but the use of the pericranium is to convey vessels into the bone, and to receive others returning from thence; as appears more especially by an artificial injection of the vessels in the periosteum of a fœtus.

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For in subjects of that slender age, the vessels of the membrane are found much more numerous than in adults; because many of the smaller vessels are obliterated and closed up as age advances (a). Therefore the pericranium being destroyed, so will be also the continuity of its vessels, upon which depends the life and nutrition of the parts, that part of the bone therefore which is thus deprived of the vital influx of its juices, will mortify and separate from the subjacent living parts.

But as Surgeons have constantly observed, that the surface of the bone laid bare from its pericranium, could not be a long time exposed to the air without a consequent corruption and exfoliation of the bone; and, on the contrary, that when the bone was bare, it very often healed without any separation, if secured from the air; they therefore imagined something malignant resided in the air, which corrupted the bone. It is indeed true, the air may contain a great many sorts of particles, which may be injurious to all sorts of wounds, as well as exposed bones; as when a great number of patients lie together in an hospital, for then the putrid exhalations with which the air is rendered foul, have retarded the cure of wounds. But then those exhalations are not to be considered as a proper part of the air, because they are lodged in it. But if the naked bone is freely exposed, the air seems by its coldness, and that property of it by which it attracts moisture, to contract and dry up the extremities of the vessels in the surface of the bones, so as to render them impervious to the juices they ought to transmit; from whence all the bad consequences naturally follow, which we enumerated in the preceding paragraph. Hence Hippocrates does not accuse the air with any malignity, but says barely, (b) *Frigidum inimicum ossibus, dentibus, nervis, &c.* “That cold is an enemy to the bones, teeth, and nerves, &c.”

S E C T.

(a) Benard. Siegfried. Albin. &c. *Icones ossium foetus, &c.* p. 160 fig. 162. (b) Aphor. 18. Sect. V. Charter. Tom. IX. pag. 204

S E C T. CCLI.

BUT the consequent effect is an increase of the malady (in 249).

When the outermost scale of a bone is corrupted from the destruction of its vessels, the disorder is then easily spread or communicated to that part of the bone immediately subjacent; and thus it may go through the whole thickness of the skull down to the diploë, and corrupt even that; the caries then may affect the internal or vitreous table of the skull, or else spreading in the substance of the diploë, betwixt the two bony tables, it may produce the very worst symptoms.

S E C T. CCLII.

THE cure is performed, 1. By gently perforating the bone, with a small trepan, down to its middle or diploë, in several distinct but nearly adjacent places, from whence the periosseum will grow up again, and prevent an exfoliation of the bone. 2. By freeing it from matter, fordes, the air, watery and fat substances, and by applying pledgets dipt in spirit or tincture of mastick. 3. By making the dressings seldom, and expeditiously.

When it appears from certain signs, that a bone of the skull, denudated of its pericranium, and exposed to the air, has been thereby so changed, as to destroy all the vital motion of the humours in the affected parts, a separation is then absolutely necessary of the head from the living parts, before such a wound can be healed. But this whole business of separation is

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performed by the living vessels next under the dead scale; which is gradually elevated, and at length cast off by the constant motion or dilatation of those vessels. And this has been very well remarked by Hippocrates (a), when he says, *In capitis vero vulnere quod ab alio quovis osse abscessurum est, sive teli vestigium in osse relictum sit, sive alioquin os plurimum nudatum sit, plerumque abscedit, ubi ex sanguine redditum fuerit* (ἀφίσταται ἐπὶ πᾶσι τοῖς ἔξαιμον); and a little after, *Ideo ab alio esse vitam & sanguinem habente potissimum solvitur, & ex sanguine & siccum factum à vitam & sanguinem habente valde abscedit*: “ In a wound of the head, where any remains of the instrument is left behind, or where the bone is by any other means much exposed, or laid bare; that bone which is about to be cast off from the rest, generally separates where it is becoming bloodless: whence again it is chiefly loosened by the next bone, which is alive and furnished with blood, but at length becoming dry and bloodless it recedes very much from that which lives and has blood.” But when this operation is left to nature only, it comes on very slowly, and usually takes up forty or more days time to compleat it. For many days are the edges of the contused bone in separating, after an opening has been made in it by the trepan (see §. 294.). But in so long an interval many bad symptoms may arise in such a wound, the disorder may be spread to the subjacent lamella, and the danger by that means be increased; and this more especially in public hospitals, where patients thus wounded are generally very badly affected, if they are obliged to stay there any considerable time, as almost all hospital Surgeons themselves confess; and own that the foul air has generally the worst effect upon those wounded in the head. Hence must be a discovery of no small importance, to hasten by art the separation of the corrupted from the sound bone. This has been attempted by scraping with

(a) De capitis vulnere, cap. 27. Char. Tom. XII. pag. 126.

with rasps, by burning with cauteries, &c. but in these methods the erased or burnt surface of the bone always remained to be exfoliated again. We observed before, that the separation of the foul from the sound part of the bone, proceeded entirely from the action of the subjacent living vessels; every thing therefore which will make a way for the subjacent living vessels to emerge from under the diseased part of the bone, will accelerate the exfoliation of the last. And the best method to do this, is by gently perforating the naked bone with many adjacent small apertures made down to the diploë with a little terebra, especially when we are satisfied there are a sufficient number of large vessels there. These little foramina are made in the bone, either by the point of a perforating trepan, or else, as I have seen practised with very good success, by a common triangular pointed needle, which being fixed in a handle, is turned round by the fingers, so as to form a small round aperture in the bone. And by repeating this in several places near each other, the subjacent living vessels being freed from their incumbent obstacle, will rise up through the little foramina, and form a new periosteum; and thus a wound of this kind frequently receives a happy cure without any exfoliation of the bone. And thus too the small vessels betwixt the lamellæ of the bone, may emerge and elongate themselves through the same apertures, and by that means cast off the incumbent foul scale. The usefulness of this method is proved by the happy success of it in practice; and the skilful Surgeon Balloste, to whom we owe the invention of this method, or at least the first accurate description of it, testifies that he has thus made a happy cure in a great number of cases, two of which he gives us in his excellent treatise on wounds, which were thus cured in the public hospital before a great number of witnesses.

A soldier had the common integuments of the skull carried away by a cannon-ball, without injuring the bone; but the pericranium was contused, so that

it appeared quite livid. He laid bare the subjacent bone, by tearing up the pericranium with his nails, and then very speedily perforated the bone in several places, as before described. Upon removing the dressings two days after, the bone appeared reddish; and after two days more, above half the naked bone appeared covered with a new pericranium; by the seventh day the entire surface of the bone was covered, and the whole wound was perfectly healed in the space of eighteen days. Another soldier had a large part of the left parietal bone of the skull laid open by a cut: at the second time of dressing the wound, he perforated the naked bone with eight or ten small apertures, so, however, as not to penetrate into the diploë, and the consequences were the same as before. For opening the wound two days after the operation the bone began to look red, and some of the vessels appeared rising up through the small foramina: after eight days the bone appeared covered with a new membrane, and the whole large wound was completely cured in the space of seventeen days (b).

From these two cases the usefulness of this method is sufficiently apparent. And at the same time they demonstrate, that only a free passage is required to be made by art, to make way for the exit of the living vessels. But from the last instance it is evident, that it is not always necessary to perforate the bone down to its diploë, but that shallow perforations will be sufficient to make way for the intermediate vessels betwixt the lamellæ, to arise and form a new pericranium; since we are told by the said skilful Surgeon, that he did this designedly, to know whether a shallow terebration only of the bone, would be sufficient to answer the same design. But when the colour of the naked bone is changed to a yellow, or more inclined to a brown, it is a sign the corruption of the bone has penetrated deep, and that therefore it will be necessary to continue the terebration down to the diploë, that the pretty large vessel

(b) Le Chirurgien d'Hôpital, &c. par Mr. Belloste, pag. 75—79

vessels which are there distributed, may cast off the foul part of the bone, and form a new pericranium.

Probably some hints of this happy practice may be comprised in that passage of Hippocrates (c), where he says, *Verum oportet, ubi os carne nudatum fuit, attenta mente conari distinguere, si non possit oculis videri & cognosci, num os fissum sit & collisum, an collisum tantum; vel num ad teli vestigium accesserit collisio vel rima, vel utrumque. Ac si quid horum senserit os, exigua terebra osse perforato sanguis detrahendus est, subinde adhibita cautione, quod os juniorum tenuius sit, &c.* “ That if the bone is uncovered of its flesh, one ought to endeavour carefully to distinguish whether or no the eye cannot trace out a fissure, and discover a contusion in the bone together, or a contusion only; or whether a fissure, contusion, or both, do not follow the course of the wounding instrument. If the bone contains any of these, blood is to be drawn from it by perforating with a small terebra, performing it cautiously in some cases, because the skull of young subjects is thinner, &c.” It is well known, that the blood will burst forth when the terebra has penetrated to the diploë: and it seems to be very evident, that this passage does not point at the cutting out a piece of the bone by a trepan, but a gentle terebration only, made by a small trepan, ’till the blood issues forth, that is, ’till the instrument has penetrated into the diploë.

2. The observations of all Surgeons who have writ on the treatment of wounds in the head, agree in this, that all fat and watery applications are injurious to wounds of the head, as we said before in §. 245.

Such substances ought therefore to be still more carefully avoided when the bone is naked, and the tender vessels beginning to sprout up through those small foramina; for watery liquors will dissolve this tender vascular pulp, and such as are oily will obstruct and render them impervious. Even the matter itself

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which

which arises from the wounded integuments, when so abundant or too long confined and attenuated, so as to become acrid, may injure and destroy this very tender repullulating compages of small vessels; and therefore the parts should be prudently deterged from this matter by scraped lint, without injuring those very tender vessels. The air must likewise be excluded, lest it destroy those vessels by its cold or drying quality, to which they were never used to be exposed, as is evident from what we said before. Belloste, in the case lately quoted, applied a pledget of scraped lint, moistened with spirit of wine, to the surface of the naked bone; and over that he again applied some mild digestive, which might act upon the lips of the wounded integument, without touching the bone. Thus the air was excluded, and all putrefaction prevented, at the same time that spirit of wine, by its corroborating power, prevented the tender vascular pulp from degenerating into a fungous excrescence. It is found by experience, that mastic, olibanum, sarcocol, myrrh, resin, &c. reduced to a very fine meal or powder, may be successfully used in these wounds, to cover and defend the parts with a balsamic crust without injuring them by any fat quality; at the same time they also exclude the air, and prevent the adjacent parts from receiving any injury by the humours extravasated into the wound. The same powder may be also used to good purpose in another form by dissolving them in a low spirit of wine (for alcohol would burn up the tender vessels), and then dipping pledgets therein, to be applied to the naked bone.

3. For nothing is more to be feared here than the free access of the air, which by its cold and drying qualities proves injurious to all wounds, but more especially to those of the head: and therefore it is that seldom renewing the dressings is so much recommended in these cases. Belloste, in the instance lately alleged, suffered the first dressings to continue on for

two days, and after that renewed the dressings every three days. So that if no itching nor great heat be perceived in the wound, nor any disagreeable smell, nor discharge of matter, the dressings may then continue upon the parts without detriment. But when new dressings are to be applied, it should be performed expeditiously : first, let the matter be imbibed with soft pledgets of lint, then apply your dressings, and cover up the wound ; for a too long or exact inspection of these wounds, as also an imprudent, or exact and harsh cleansing of them, abrades the soft mucus, of which are formed the small growing vessels. It will be still more serviceable, if before the wound is undressed, you place a little shell on each side of it, with some live coals, upon which is sprinkled some stastic, amber, olibanum, or the like fumigating substances ; whereby a warm atmosphere, full of grateful and corroborating aromatic fumes, will encompass the wound on all sides.

S E C T. CCLIII.

BY this artifice a new fleshy sort of substance speedily arises every way, out of the perforations or apertures (252), and then the remainder of the wound (249) is cured as before (245 to 249).

In what sense the substance arising out of the perforations in the bone is said to be flesh, we have before explained in §. 158. numb. 9. Belloste (*a*), who has so well described what relates to this affair, does by a very apt phrase term it a germination ; the foramina of the bone after the second day began (*germer*) to sprout or bud. For out of those foramina a sort of mucous substance, in appearance gradually arises, which being viewed with a microscope, exhibits very

B b 4

small

small vessels ; and even the motion of the little arteries are distinguishable in this mucus. The vascular compages emerging out of these small foramina, meets or conjoins with the like substance arising out of those adjacent, and thus repairs the lost membrane, and that so speedily, that within seven days time the naked part of the skull, equal to about the size of a florin, was found covered over by Belloste in the instances before cited, under the preceding aphorism.

It is now fourteen years ago since I had occasion to examine accurately the said vascular pulp, arising out of these foramina of the bone, in a case extraordinary enough. A man aged fifty years, in an acute continual fever, did by a sudden metastasis of the morbid matter, in one night's time, lose all the extreme part of his right foot, even to where the tarsal and metatarsal bones are articulated together. The part was in this short time so perfectly sphacelated, that the patient did not perceive the least pain, even upon thrusting the scalpel down to the bone, nor did any blood issue from the wound. By the application of such remedies as prevent the dead parts from corrupting, and defend the living parts from being invaded by the disorder, in five days time they so happily succeeded, that a separation appeared betwixt the dead and living parts, and gave great hopes of a cure, which 'till then was much to be doubted. After an entire separation of the dead parts from the sound, the tough tendons were divided with a pair of scissars, by an expert Surgeon, and thus the patient happily escaped from so dangerous a malady, with the loss of the whole anterior part of his foot, and is yet living. In this case the bones of the tarsus, which were next to the metatarsus, appeared to have contracted no small part of the disorder. For a considerable part of them projecting beyond the surface of the amputated parts, were turned black, and occasioned new difficulties. So much of these foul bones were sawed off, as could well be performed, without injuring the circumjacent soft parts.

parts. But even still the dead surfaces of these bones remained to be exfoliated, before the wound could be healed with a firm cicatrix.

In this case the judicious Surgeon perforated the surface of the foul bone with a great many and adjacent small foramina, and in two days afterwards he observed with a great deal of pleasure, that the small foramina grew moist or mucous, and upon inspecting them with a microscope, small vessels appeared very distinctly in all of them, having a real systole and diastole, which perfectly corresponded to the patient's pulse, felt at the same time in his wrist. Hence it evidently appeared to us, that the substance emerging out of the small foramina, was a true vascular communication.

But when by this method the naked bone is covered over with a new membrane, the remainder of the cure is then compleated in the manner described before, in numbers cited by this aphorism.

S E C T. CCLIV.

WHEN the skull is injured, it may be damaged, according to the different circumstances of the wounding cause, or instrument, either by a fissure, fracture, contusion, depression, or evulsion of a piece; and these either in one or in both of the tables at the same time.

After having considered what may happen to the common integuments and to the pericranium from wounds, we now come to treat of such wounds as injure the bones themselves of the skull; and first, in this aphorism are comprised the several ways in which the bones of the skull have been observed to be injured, according to the different figure of the wounding instrument, and the greater or lesser force with which it was inflicted.

Fissure.] A fissure is generally an oblong and narrow division, or solution of continuity in the bone, which is still continuous in some part. A great diversity obtains among these fissures, according to their magnitude, and oblique or rectilineal course, with the different bones of the skull, in which they are seated: some are placed in the external table of the skull, and others in the intrenal table, the external one appearing at the same time sound. And sometimes the fissure is not in the part injured by the wounding instrument, but in some other distant, or even opposite place in the skull; and in that case it is called a counterfissure, of which there are many instances given us by authors. Thus Tulpius (*a*) relates, that a man who was struck on the occiput with the end of a gun, died on the sixth day, notwithstanding the skull was immediately trepanned: and after death, the skull exhibited many fissures internally, though it appeared sound externally. And Parey (*b*) confirms the same thing by two instances. A man, by a blow with a stone, received a violent contusion, with a swelling, and a small wound upon the right parietal bone; after dilating the wound, the bone appeared sound, and yet the wounded patient expired on the twenty-first day after it was inflicted. Upon sawing off the top of the cranium, after the patient's death, the parietal bone on the opposite side, appeared to be fissured. In another patient, a nobleman, after a violent contusion of the head, notwithstanding it was armed with a helmet, after his decease, the internal table of the skull appeared fractured, so that the broken fragments were fixed into the substance of the brain, notwithstanding the exterior table of the cranium appeared altogether entire. Hippocrates (*c*) also has remarked this, and after enumerating the various methods, in which the skull may be injured, he adds at last, that when the bone

(*a*) Observat. Med. Lib. I. cap. 2.(*b*) Lib. X. cap. 8.(*c*) Hippocr. de capit. vulner. cap. 10. Charter. Tom. XII. pag. 119.

bone is injured in a different part of the head from where the wound is seated, that then the malady is incurable, because one cannot discover in what part of the head it lies : whence Celsus (*d*) also affirms, *Sigra-viter aliquis percussus est, si mala indicia subsecuta sunt, neque ea parte, qua cutis discissa est, rima reperitur, non incommodum est, parte altera considerare, num quis locus mellior sit & tumeat, illumque aperire, siquidem ibi fissum os reperietur. Nec tamen magno negotio cutis sanescit, etiamsi frustra secta est* : “ If any one has received a
 “ violent blow on the head, attended with malignant
 “ symptoms, and no division can be perceived in the
 “ bone where the skin is divided, it will be proper to
 “ examine the other side, whether any part can be dis-
 “ covered softer and more tumefied then the rest, and
 “ there to make an opening, if the bone shall appear
 “ fissured. Nor will it be any great difficulty to cure
 “ the wound of the integuments, if they should be
 “ incised to no purpose.” But all this is uncertain, since the fissure has been often found in the same bone, though not near the part wounded. Thus a man received a blow from a club, on the forehead, over the right eye-brow, which proved mortal, and yet no damage appeared in the bone under the wound, but a counterfissure was found in the right orbit of the eye, extending for an inch and half towards the sella turcica (*e*). Even sometimes the fissure has been found to extend from the parts wounded, into another bone of the head : of which we have an instance given us by Ruysch (*f*) where, by a violent contusion on the left parietal bone, a fissure extended not only through that bone, but also went on over the futura squamosa, through the os temporale, and also quite through the os petrosum, and os occipitis, down to the margin of the great foramen in this last bone, through which the medulla oblongata passes into the vertebræ. From
 which

(*d*) Lib. VIII. cap. 4.
 vulner. pag. 142.
 Centur. Observ. 47.

(*e*) Joh. Bohn. de renunciat.
 (*f*) Observat. Anatom. Chirurgic.

which case it is evident, that the futures do not always prevent a fissure from extending out of one bone of the skull into another adjacent, as many persuade themselves.

Fractured.] A fracture of the skull differs from fissure, because in this last, the continuity or cohesion of the bone still continues in some measure, but in a fracture there is supposed an entire separation of the parts. But a fracture may be so circumstanced, that the fragment may be wholly separated from the bone or else it may adhere united to it in some particular part. And when the fragment is entirely separated by the wounding instrument, it is generally pressed inwards, and injures the brain. To fractures may be also referred what Hippocrates calls (*ἑδρην*), the mark or impression of the wounding instrument; as when for example, a wound being inflicted by a scymitar cuts through all the integuments, and enters the bone itself. For he says, (*g*) *Sedes (teli) autem dicitur, cum osse in sua natura permanente, telum ossi infixum manifestum fecerit, qua insederit*; and then adds, that *præcisio* (*διακοπή*), *quantamcunque longitudinem & latitudinem ossi occupet, ad teli vestigium referatur, modo alia ossa, quæ præcisionem circumambiunt, maneant in sua natura, neque una cum præcisione desistant*: “The tract of the instrument is said to be, when it is fixed in the bone, so as to make it evident which way it entered, the bone continuing in its place; also the cutting off a part of the bone is to be referred to the tract or course of the instrument, how far soever it may extend in length and breadth, provided the other bones, surrounding that wounded, remain in their natural position, and are not depressed, or removed with the former.” For when the bone is loosened on every side, and changes its place, or is depressed, he would not then have it called the impression of the instrument, but (*ἑσφλασιν*) a forcing, or contusion of it inwards,

inwards, namely when the bone is on every side broke off and depressed (*b*).

Contused.] That is, when the skull is so injured by a heavy and obtuse instrument, that no slit nor fracture appears. For as a contusion may rupture a great many vessels of the soft parts without breaking the skin, so likewise a blow may produce the same effect in the bones of the skull, when the intermediate vessels running betwixt the bony lamellæ are injured by the contusion, without altogether dissolving the continuity of the bone. This case is frequently difficult to discover before it is become too late, when the malignant symptoms make it evident that the bone is thus injured. This disorder is called by Hippocrates (ῥαδσιν) a contusion; and he also tells us, that the eye cannot judge in what degree the substance of the bone is contused, nor how far the injury has penetrated (*i*). For if the vessels distributed betwixt the two tables of the skull, in the substance of the diploë, are ruptured by such a contusion, though the substance of the bone seems to be whole, yet it is evident, that by the corruption of the extravasated juices, the worst symptoms may be brought on, the internal table of the skull may be eroded, and the disorder that way communicated to the meninges, and to the brain itself.

Depressed.] This may be done two ways; for either the fractured part of the bone may be entirely separated from the adjacent bones, and subside; or else the whole bone may be depressed, notwithstanding its adhesion to all the rest continues as at first. This accident generally happens to young skulls from an obtuse wounding instrument; because in these the bones are more flexible, and more easily bend without breaking. Yet such depressures are often found in the skulls of adults likewise: because the bones of the cranium in a living subject are very moist, and less friable, than the bones of a dried skull appear

(*b*) Hippoc. de capit. vulner. cap. 8. Charter. Tom. XII. p. 118.

(*i*) Ibidem, cap. 7. pag. 118.

appear to be, in the skeleton. But it is more rare to meet with such a deprefsure in adults, without some fissure or fracture also accompanying it.

Or by the loss of a fragment.] Which is frequently removed from the bone by a cut, when the instrument takes off a part of the bone with the wounded integuments. This is often called a shaving of the skull: of which Scultetus (*k*) gives an instance, where a fragment of the cranium was taken off as large as a rix-dollar, and yet the patient was happily cured of the wound. It has been also found, after violent contusions of the head, that a fragment has been separated from the internal table of the skull, so as to injure the subjacent brain, as we just mentioned a case under the present aphorism, from Parey.

Now all the accidents before enumerated, may either injure the external table of the skull only, or the internal table only, or both together at the same time; but the case is always the worse, as they have penetrated more towards the internal parts; for it is very evident, that the cure must be then much more difficult.

S E C T. CCLV.

THAT the parts are thus (254) affected may be known; 1. From the violent cause of the wound; 2. From the size of the wound compared with its figure; 3. By the probe; 4. By pouring ink upon the skull; 5. By a grating of the bones, when the patient bites any thing; 6. By the appearance which the fractured, contused, or punctured parts of the white skull, make to the eye, when thus tinged; 7. By the touch itself; 8. From the symptoms of the wounded integuments; as when the flesh recedes from the bone.

(*k*) Armamentar. Chirurg. Observ. XVII. pag. 214.

bone about the seventh day, a pain is felt, the nature of the pus is thin and foetid, or some uncommon malignity of the wound is perceived.

Since the most malignant symptoms may proceed from injuries of the skull, as will appear in the aphorism next following ; therefore the most diligent enquiry ought to be made, whether or no the skull itself has received any damage from the wounding instrument. That a hasty or confused examination will not be sufficient to make this discovery we are assured from Hippocrates, who ingenuously confesses himself to have been unfortunately mistaken in this respect, by not distinguishing the mark of the instrument from a future, as we observed before in §. 172. numb. 3. But the discovery of this may be made from the signs following.

1. It is very evident, that a violent blow inflicted on the head, either by an obtuse or sharp wounding instrument will necessarily injure the skull. But this injury will more evidently appear to the eye, when the skull is laid bare by a division of the integuments with an edged instrument, than when an obtuse weapon injures the skull without wounding the integuments, or with making but a very small visible wound.

2. Of this we spoke in §. 240. numb. 3. For in those parts of the skull where the bones are flat, a large wound may be made in the integuments without injuring the bone ; but where the bones of the cranium have a considerable convexity, or in those parts where they form a projecting angle, no great wound can be made without entering the prominent part of the bone, unless the wounding instrument divides the integuments, by turning round in a manner, which very rarely happens.

When skilful Surgeons are called to a patient thus wounded, they gently wash the wound with some
warm

warm water, mixed with a little wine, and a few grains of salt; then carefully removing the lips of the wound, they enquire whether any injury appears in the bone itself. They next take a smooth probe, having a round or obtuse head, and insert it into the wound; but the probe should be slender and very pliable, formed best of the purest silver, suffered to cool gradually in the air, without extinction. By moving this instrument every way, they endeavour to perceive whether the bone is naked, which may be easily known by the sound of the probe against the hard bone; and then they direct the probe over the whole surface of the bone, to discover whether any roughness can be perceived. To perform this without danger of error, Celsus (a) directs, *Specillum oportet esse nec nimis tenue, neque acutum; ne, cum in naturales quosdam sinus inciderit, opinionem fracti ossis frustra faciat: neque nimis plenum, ne parvulae rimulae fallant. Ubi specillum ad os venit, si nihil nisi leve & lubricum occurrit, integrum id videri potest: si quid asperi est, utique qua futurae non sint, fractum os esse testatur*: “ That the probe
“ ought to be neither too slender nor too sharp point-
“ ed, lest when it falls into some of the natural fi-
“ nesses of the bone, it may make one falsely imagine
“ it to be fractured; nor yet ought the head of it to
“ be too large, lest small fissures should escape it.
“ When the probe reaches the bone, if nothing can
“ be felt in it but what is smooth and slippery, it may
“ then be judged entire: but if any roughness is felt,
“ in a part where there is no future, it is a sign the
“ bone is fractured.” Whence it is evident, that great attention ought to be had to the parts where the futures are, and which are sometimes different in different men, and at different ages. Thus the sagittal future runs through the os frontis in young skulls, dividing that bone into two, down to the root of the nose; but this is gradually obliterated in the more adult: though there are also some men and women

advanced

advanced in years, who have the sagittal future disposed in this manner; and therefore in wounds of the forehead, this future ought to be remembered. In extreme old age again, all the futures of the skull frequently disappear, and sometimes sooner. After the Plataean battle, when the bones were collecting together in one place, a skull was found without any futures, consisting all of one bone (*b*); and it even appears from certain observations, that sometimes the futures are also quite obliterated in younger skulls. Thus no appearance was to be found of the sagittal and coronal futures in the skull of a child about eight years old, neither on its external, nor internal surface. And the celebrated Hunauld (*c*) has even observed these futures beginning to be obliterated in children still younger; and therefore he believes that this case happens oftener than is commonly imagined. And besides this, there are some parts in the skull which have a natural roughness, as in the os occipitis. And frequently the futures are wonderfully different in different people; for example, I keep a skull by me, the sagittal future of which, near the occiput and forehead, is extremely narrow, but near the vertex of the skull, that future runs in and out to near the breadth of an inch, in an extraordinary manner. And this has been also deservedly remarked by Hippocrates (*d*) himself, in the beginning of his book on wounds of the head, where he says, *Quod hominum capita neque inter se similiter abeant, neque futuræ capitis omnibus in eodem loco sitæ sint*: "That the skulls of men are neither shaped alike, nor are the futures of the skull fixed always in the same place."

There is frequently therefore much room to doubt in this respect, even after an examination has been made with a probe; and it is much the most difficult to discover the injury of the bone, when the

(*b*) Herodot. Calliope, pag. 540.

an 1734. Hist. pag. 59.

ap. 1. Charter, Tom. XII, pag. 115.

(*c*) Académ. des Sciences

(*d*) Hippocrat, de capit. vulner,

wound is inflicted near the futures: in which case, even Hippocrates confesses himself to have been deceived, an acknowledgment, in the words of Celsus (e), *More scilicet magnorum virorum, & fiduciam magnarum rerum habentium. Nam levia ingenia, quia nihil habent, nihil sibi detrahunt. Magno ingenio, multa que nihilominus habituro, convenit etiam simplex veri erroris confessio, præcipue in eo ministerio, quod utilitatis causa posteris traditur, ne qui decipiantur eadem ratione, qua quis ante deceptus est:* “ Agreeable to the genius of
 “ great men, and the fidelity of those who have to
 “ deal with important matters. For small wits, ha-
 “ ving nothing to lose, never detract from or diminish
 “ themselves. But it becomes a great genius, and
 “ one whose field of experience is very large, to make
 “ a naked confession of any real error, especially in
 “ those concerns which are handed down for the good
 “ of posterity, to prevent any one from being de-
 “ ceived in the same manner that his predecessor
 “ was.”

4. When there is great reason to suspect that the skull is injured, as well from the known kind and violence of the wounding instrument, as from the consequent symptoms in the patient, a vertigo, stumbling, sopor, &c. and yet at the same time neither fissure nor contusion can be perceived in the bone, either by the eye or probe; in this case Hippocrates advises another method, by which one may possibly discover the latent injury; which being neglected, might afterwards produce the most fatal consequences. He orders some fluid medicine that is of a black colour to be applied to the bone, and the wound to be dressed with lint moistened with oil, and after applying a cataplasm of maize or turkey-wheat, to bind it up. On the next day, after undressing and cleansing the wound he would have the bone scraped, for then if the bone is fissured or contused, it will appear black in that part, at the same time the rest of the bone will ap-
 pear

(e) Celsus, Lib. VIII. cap. 4. pag. 515.

pear white (*f*). It is therefore evident, that all which is necessary there, is to cover the bone with some coloured liquor, after wiping off which it will discover whether any fissure or contusion is in the bone, because the colour penetrating deeper there, cannot be wiped off so easily as from the plain surface of the skull, where there is no injury sustained.

But whether Hippocrates would have writing ink used here, does not appear from this place; though Celsus (*g*) seems to have translated it so, where it says, *At, si ne tum quidem rima manifesta est, inducendum super os atramentum scriptorium est, deinde scalpro id de-radendum, nigritiem enim continit, si quid fissum est.* “That if the fissure does not appear, writing ink is to be poured over the bone, to be afterward scraped off with a scalprum, and if any part is fissured, it retains the blackness.”

But in Ægineta (*h*), it is proposed to detect a latent, narrow or hair-like fissure, by some liquid and black medicine, or by a writing black (φαρμακὸν τι μέλαν ὑγρὸν, ἢ ἢ αὐτὸ τὸ γραφικὸν ἐγχείαντες). But the Ancients used the juice of the cuttle-fish, and perhaps other liquors for ink: at least the ink which is now commonly used, seems not so proper for this purpose, unless it was very much diluted, since it consists of galls, granate-peel, or the like astringents mixed with vitriol, which applied to the tender vessels of the naked bone, would so contract them, that the lamella of the bone, whose vessels were thus destroyed, must be afterwards separated. Nor is there any manner of necessity for using writing ink, since any coloured liquor will answer the design; but if a black colour is preferred, one may be made from bones calcined to blackness, reduced to a subtile powder, and dissolved into water as also from many other substances prepared in the same manner.

C c 2

But

(*f*) Hippocrat. de capit. vulner. cap. 23. Charter. Tom. XII. pag. 124, 125.

(*g*) Lib. VIII. cap. 4. pag. 515.

(*h*) Lib. VI. cap. 90. pag. 86. versa.

But it seems sufficient barely to tinge the naked bone with a liquor of this kind, and then to wipe it off again with a sponge; nor is there any necessity for scraping the whole surface of the bone with a scalprum, since then a new separation of the erased surface must be waited for; as we shall observe in §. 266. Now as one may be deceived by the examination with a probe, made near the futures, and in those parts where the surface of the bone is naturally rough; so one may also be deceived by this coloured liquor insinuating betwixt the futures, and lodging in the inequalities of the skull.

5. In the Coan prognostics of Hippocrates (i) we are told, that when it is doubted whether the skull is fractured or not, the wounded patient ought to take a piece of the stalk of asphodel, or fennel-giant, in his mouth, and chew it betwixt his teeth, observing at the same time, whether any grating can be any where heard in the bones of the skull; for the fractured parts may be perceived to afford a noise. But it is very evident, that this grating of the bones cannot be perceived, unless the fractures be pretty considerable: and certainly a fissure of the skull can never be this way discovered. For the whole import of this sign consists in this, that the temporal muscles forcibly approximating the lower jaw against the upper in mastication, as they arise in a broad expansion from each side of the skull (as well from the upper process of the os jugale, the adjacent side of the os frontis, from the largest process of the os sphenoides, the os parietale, and the squammose part of the os temporale) therefore when these muscles act, if there be any considerable fracture near their insertion, they may move the fractured parts, and occasion a grating sound: and since these muscles are so broadly expanded, and inserted into so many different bones of the skull, it is evident, that fractures may be thus discovered in many parts, when they are very large or considerable.

Surgeons

(i) No. 501. Charter. Tom. VIII. pag. 881.

Surgeons frequently give the wounded patient an iron key to bite, for the same purpose: or else order them to hold the end of a chord fast betwixt their teeth, and pulling it tight with one hand, they strike the tense chord with one of their fingers; and at the same time direct the wounded patient to observe, whether he can perceive any motion or grating in any part of his skull.

6. When the wound is laid sufficiently open, either by accident or art, so that the naked bone may be viewed with the eye; then the fracture or fissure, if there be any, will appear sufficiently conspicuous. But when a bone is contused without either fracture or fissure, it is an accident more difficult to discover, as Hippocrates (*k*) has observed, and as we mentioned under the preceding aphorism.

The principal sign afforded in this case, is a change in the natural colour of the bone, which is generally reddish, or a little inclined to blue. If now the bone is beset with white specks, it is a sign the subjacent vessels, which coloured the pellucid lamellæ of the bone, are become mortified, and are no longer pervious to the juices they ought to transmit; and therefore a separation must be expected of the bony lamella, destitute of its subjacent vessels.

7. It must be carefully observed here, that the touch with the finger is often deceitful, so that one may imagine the bone is thus pressed inward, when in reality it does not stir. In violent contusions of the head, the integuments of the cranium are often so much injured by their forcible pressure against the subjacent hard bones, that a great number of vessels being thus ruptured, a copious and sudden collection of the extravasated juices is formed under entire skin. If now the margin of such a tumour be pressed with the finger near the sound parts, it will appear as if the subjacent bone sunk inward; the reason whereof is this: the integuments of the cranium are very thick,

C c 3

and

and especially the skin is so; but these being distended and elevated from the subjacent parts by the extravasated humours, collected in the cellular membrane therefore the skin will be gradually elevated from the margin of the sound parts, where it adheres, to the part where it recedes most upon the tumour; so that upon pressing the finger on the margin of the tumour near the sound parts, it will seem as if the bone was then depressed, only because the thick skin is there elevated from the subjacent bone and pericranium. This is a circumstance that has frequently deceived even very skilful Surgeons: and even (*l*) Ruysch himself confesses, that in examining a large tumour upon the forehead with his fingers, that arose after violent contusion, he should have imagined that the cranium was depressed, as a Surgeon then present would persuade him, if he had not learned by manifold experience, that the touch might deceive one in such case.

8. From these signs indeed it may be known whether the skull is injured, but the discovery is frequently made too late; when the most malignant symptoms following, unexpected both by the Physician and Surgeon, destroy the patient. When wounds of the head are inflicted without any injury to the skull, they are frequently cured in a little time, even tho' they were large ones, provided those circumstances are observed which we mentioned in §. 245, and 252. But when the skull has been also injured, without its being discovered by any of the forementioned signs, the wound is then usually treated as a simple one; and often for the first few days every thing will seem to succeed very well. In the mean time, the subjacent injured bone begins to corrupt, the integuments begin to separate from the diseased bone, the pain increases, no more laudable matter is formed, but the wound discharges only a thin and often very ill-smelling ichor, and resisting the use of all the best remedies, signifies

infallible

(*l*) Observ. Anatom. Medic. Centur. Observ. LX.

infallibly that some latent evil lies concealed. But all these symptoms arise sooner or later, according to the degree of the injury, habit of the wounded patient, and particularly, the more or less heat of the weather. All this has been beautifully observed by Hippocrates, who after enumerating the signs by which a fracture of the skull may be known, adds: (m) *Progressu vero temporis fracta partim septimo, partim decimoquarto, partim etiam aliter significationem præbent. Nam & carnis ab osse abscessus fit, & os lividum, & dolores, ichoribus effluentibus. Hæc autem ægre jam auxilium admittunt*: “That in process of time the fracture discovers itself partly on the seventh, partly on the fourteenth, or on some other day. For the flesh departs from the bone, which turns livid, pains arise, and an ichor is discharged. But all these then very difficultly admit of relief.” And in another place (n), where he delivers the signs relating to wounds of the head, he says: *Si os fractum, aut fissum, aut contusum fuerit, &c. neque per errorem rase-rit aut secuerit, tanquam sectionem non postulet, sed sanum os existat, ante dicimumquartum diem hyeme plerumque febris invadet, æstate vero post septimum. Et ex illo paucus ichor effluit, & quod in eo inflammatum est, moritur: ubi illud contigerit & ulcus d. color sit & glutinosum, & apparet instar salsamenti (ὡς πικρὸν τὰ ἰχθὺς) colore fulvum sublividum, & os deinde corrumpi (σφρακελῆσιν) incipit, & nigrescit, læve existens, ad extremum autem subpallidum & exalbicans evadit. Cum vero jam purulentum extiterit, pustulæ in lingua exoriuntur & delirans moritur*: “If the bone should be fractured, fissured, or contused, and the Surgeon erroneously neither rasps nor trepans it, because he thinks the bone sound, and the operation unnecessary, a fever generally invades the patient before the fourteenth day in winter, and about or after the seventh day in summer. From the wound is also discharged a

(m) Coac. prænot. No. 501. Charter. Tom. VIII. pag. 881.

(n) De capitis vulnere. cap. 31. Charter. Tom. XII. pag. 127.

“ small quantity of ichor, and the parts inflamed in
 “ it mortify: when this happens, and the ulcer
 “ looks discoloured, glutinous, and like salt meat, of
 “ a shining, or livid colour, the bone thence begins
 “ to corrupt or turn black, becomes light or spongy,
 “ and looks outwardly of a pale yellow, or whitish
 “ colour. But when the bone is absolutely become
 “ purulent or carious, pustules arise in the patient’s
 “ tongue, and he expires delirious.” Thus, accurately, has Hippocrates, in this place, described all the symptoms. For so long as the lips of the wound look red, and but little inflamed, the skilful Surgeon fears no great danger; but when the vivid colour disappears, and the lips of the wound begin to look like flesh that is stale, or has been long salted, they know very well that the worst consequences are at hand. And therefore, after Hippocrates, the most skilful Physicians did not so much fear the bad symptoms arising soon after the accident; but severely condemned those which appeared afterwards, and especially about the seventh day, as we observed before in §. 240 numb. 4.

For these reasons Hippocrates (o) pronounces it very fatal for a fever to arise in wounds of the head, about the seventh, or fourteenth day.

Since therefore injuries of the bones of the cranium, even though slight, may be followed with many, and those very bad symptoms (concerning some of which we have already spoken, and of the rest we shall treat under the following aphorism), it is therefore evident, that we ought, with all possible care, to enquire after, and detect them in the beginning, that they may be timely relieved: we have now enumerated the signs, several of which, more especially concurring at the same time, will afford a pretty certain diagnosis. But the symptoms last mentioned in the two preceding paragraphs of this number, do, indeed, afford a most certain sign that the bone is injured, but then the malady is hereby generally discovered too late, having

(o) Proorrh. Lib. II. Charter. Tom. VIII. pag. 818, 819.

having lain 'till now concealed, when if it had been detected sooner, it might probably have been cured.

From what has been hitherto said it is evident, why skilful Surgeons never neglect, or slightly regard, wounds of the head, even such as are in appearance trivial; since a latent injury of the bone may escape the most skilful, and sometimes, when the integuments only are injured, yet the subjacent bone may be corrupted by the air, matter, &c.

S E C T. CCLVI.

THE consequent effects of this injury (254), are, 1. a mortification of the part of the bone separated (249, 250, 251;) 2. an infection of the adjacent parts; 3. and from thence often follows a caries or putrefaction of the whole infected bone; 4. a caries of the diploë; 5. a corruption of the integuments of the cranium and brain; 6. and from thence the symptoms of a diseased brain, convulsions, lethargy, palsy, apoplexy, and death.

1. A mortification arises in the bone from a destruction of the arteries in the periosteum, which convey the vital humours to the bone; as also from a like destruction of the reductory veins returning the same humours from the bone. Whenever therefore these vessels are deprived of their office, the lamella of the bone mortifies, to which those vessels are sent. Now whether the vessels leading to the bone are destroyed by an injury of the pericranium, or an erosion of the vessels themselves dispersed betwixt the lamellæ of the bone, and detached from the pericranium; or lastly, a destruction of the vessels which enter into the diploë, by particular foramina in the external plate of the skull, the effect of either will be the same, namely, a mortification of the part deprived of

of the vessels, which used to supply the vital humours. But all parts of the body, deprived of the vital influx of juices, can never grow again or unite to other parts which are living, but must be always removed from the living parts adjacent; and therefore the bony lamellæ being mortified, ought also to be thus removed or exfoliated, as we observed in the comment on §. 249.

2. The bones of the cranium are composed of several lamellæ lying incumbent one upon another, betwixt which are distributed very small vessels; at least before those vessels are effaced by the closer approximation of the lamellæ. This was proved in the commentary on §. 249, and confirmed by the happy contrivance of perforating the bone with little apertures not so deep as the diploë; and yet out of those pin-holes we see small vessels arise, by whose action the dead scale of the bone is cast off, and the lost pericranium regenerated, as we observed in the comment on §. 252. This proves therefore that there are vessels in the bony substance of the external table of the skull, which being freed from their incumbent lamellæ, sprout or elongate, and form the vascular compages arising out of those foramina. This is confirmed by a remarkable observation of Tulpius (a). A man being struck on the occiput with a musket, though no fissures appeared, yet the malignity of the symptoms called for the trepan, and while the Surgeon was applying it, innumerable drops of blood issued from the whole bone like dew, which returned again after being several times wiped off with a sponge. It is therefore evident, that the blood has a passage by the continuity of the vessels, even through the compact substance of the bones themselves, so as to be capable of transfusing through the external surface of a bone like dew: if therefore the exterior lamella of a bone be mortified, the disorder may be easily communicated to the subjacent vessels, from the injury of which the

next

(a) Observat. Medic. Lib. I. cap. 2.

next lamella following will be affected; and thus may the disorder be propagated through all the lamellæ composing the external table of the skull, afterwards it may affect the diploë, and then the internal table, so as to corrupt the whole, &c.

3. From what was before said, it is sufficiently evident, that a destruction of the vessels causes the part to die, whence follows a spontaneous corruption of the part mortified. And in the comment on §. 242, such an instance was alledged, where after a violent contusion of the head, the man died suddenly after the expiration of ten months time, his skull being found quite putrid and stinking. We have also a remarkable case in Parey (*b*), from which it appears that the cranium may in this manner be totally corrupted, and the putrid part separated, and yet the patient survive. A man was wounded with a sword in the left parietal bone, but yet without entering the interior plate of the skull. When the wound was near healed, the patient, indulging himself freely with wine and hot meat with his companions, was taken with an acute fever, attended with the loss of his speech and senses, with a considerable tumour of his head and face. After a few days, an abscess was formed in the head, which being opened with a lancet, discharged a large quantity of ichor, the subjacent bone of the skull also appearing black, putrid and foetid through its whole substance, and afterwards a great many live worms made their nest there. The corrupted bone separated as broad as the palm of one's hand; and the patient was, notwithstanding, perfectly cured of this dangerous malady, only that the cicatrix remained very weak and sensible for a long time after.

4. When the corrupted bone drops as it were into a powder, it is then termed a caries of the bone, which is very distinct from the separation of the corrupted lamellæ by exfoliation. The diploë betwixt the two plates of the skull is composed of a great many

many vessels and bony cells; and there is here also deposited a medullary oil, which very speedily corrupts. So that when the disorder invades the diploë, either from the disorder propagated from the bony lamellæ, or from the humours extravasated within the diploë by the violent contusion, while the plates of the skull are entire; from either of these causes will arise a corruption of the stagnating and extravasated juices, by which the vessels that are not yet touched may be quite eroded, and the disorder thus increased, which spreading itself slowly through the cells of the diploë, betwixt the two plates of the skull, may extend itself largely: and at the same time it is also very evident, that the diploë being thus affected, may destroy both tables of the skull, whence an infinite number of maladies follow.

5. The pericranium covers the convex part of the skull; and the dura mater, which forms the internal periosteum of the cranium, firmly adheres to its concave surface: both these membranes detach vessels into the adjacent bones, and also receive others from them; and it seems very probable, that the vessels of the pericranium passing into the diploë through the external table, do there communicate and unite with the like vessels sent from the dura mater, and entering through the internal table to the diploë. When the bones or plates of the skull therefore are thus injured, and especially when the diploë is thus affected, it is evident, that both the external and internal integuments of the skull may be also affected by the continuity of the vessels; the truth of which is also confirmed by the history before-mentioned in numb. 3. But the internal integuments of the cranium being thus affected, will easily spread the disorder into, and corrupt the soft brain contiguous, as we are assured by many observations.

6. All the senses and voluntary motions depend on the brain, as is evident from physiology. The brain therefore being corrupted or injured, may disturb or abolish

abolish either some, or all of those actions, as the disorder either infects the whole brain, or only some certain parts of it. But when the malady creeps on slowly from the diseased bone, so as to affect the brain itself, it often excites these symptoms in the order in which they are here enumerated. It is here sufficient to remark, that all disorders of the brain have been observed to arise from this cause, even from the slightest vertigo to the most fatal apoplexy.

S E C T. CCLVII.

FR O M whence (254, 255, 256.) the diagnosis and prognosis of the disorder may be understood and deduced.

From all that has been said in and under the aphorisms here cited, one may determine how far art is capable of affording relief, and whether the skull is injured or not: yet so, that if the wounding cause was violent, that there is always some reason to fear a latent injury, though none can be discovered to the senses: as when, for example, the skull is fissured in a distant part from where the injury was inflicted, as mentioned in §. 254. But when from the given signs it appears that the skull is injured, then all those accidents are to be feared in the prognosis, which are enumerated in the preceding aphorism; not that they always follow such injuries; but because they possibly may follow, prudence requires the Surgeon to acquaint the patient's friends with all this, lest the accidents which happen afterwards should be attributed to his inaccuracy, rather than the malignity of the wound. And besides this, when the patient and his friends are told what bad accidents may possibly follow wounds of the head, which are in appearance slight, they will the more carefully observe every thing that is required of them in the diet, regimen, and treatment of the wound;

wound; and from a neglect in which, sudden death has often followed, even when all danger has been thought to be over.

S E C T. CCLVIII.

THE indications for a cure, are, 1. to lay open the injured part; 2. to cleanse the wound; 3. to perforate the bone; 4. to procure a regeneration of its periosteum; 5. to heal the rest of the wound.

It is much to be doubted, whether it is always absolutely necessary to lay the bone bare, even when there is a strong suspicion of the skull being injured. For why may not a fractured or fissured bone of the skull unite again in some cases, as well as in the other bones of the body? It therefore seems proper to avoid both extremes: since there are some Surgeons, who incise the scalp for almost all injuries of the head without distinction; and others again are so fearful, that they durst hardly perform it, even in the most dangerous cases. Ruysch (a), who had seen so many cases of this nature, in his many years practice, in a populous city, says, that in real fractures of the skull, where the symptoms are neither violent nor increase, one ought not to proceed immediately to incision, and trepanation; but after opening a vein, and applying warm cephalic fomentations, the cure ought to be attempted; and adds, that he had thus happily cured many who were almost under the operation. The same advice is also given by Celsus (b), for he says, *Antiquiores medicos in omni fisso vel fracto osse statim ad ferramenta venisse, quibus id exciderent. Sed multo melius est, ante emplastra experiri, quæ calvariæ causa componuntur, &c. Si autem caruncula increscere cæperit, & febricula aut soluta*

(a) Observ. Anatom. Chirurg. Centur. Observ. LX.

(b) De Medicin. Lib. VIII. cap. 4. pag. 517.

soluta fuerit aut levior, & cupiditas cibi reverterit, satisque somni accedat, in eodem medicamento erit perseverandum, &c. Hac ratione sæpe rimæ callo quodam implentur; estque ea ossis velut cicatrix. Et latius fracta ossa, si qua inter se non cohærebunt, eodem callo glutinantur. Estque id aliquanto melius velamentum cerebro, quam caro, quæ exciso osse increscit. Si vero sub prima curatione febris intenditur, brevesque somni, & iidem per somnia tumultuosi sunt, ulcus madet, neque alitur, & in cervicibus glandulæ oriuntur, magni dolores sunt, ubique hæc fastidium increscit; tum demum ad manum scalpriumque veniendum est: “That the more ancient Physicians had recourse to instruments in almost all fractures or fissures in the skull; whereby they cut them out; but it is much better to try emplasters first, which are made for the use of the head or skull, &c.” And this method he thinks ought to be tried ’till the fifth day: “And if then the fever goes off or lessens, a sort of caruncle begins to grow, the patient’s appetite returns, and he sleeps tolerably well, the same method of cure ought then to be continued, &c. By this means the fissures are often filled with a sort of callus, which is to the bone as a cicatrix to the skin. And when the bones are more considerably fractured, so as to leave the intermediate spaces betwixt them, they will nevertheless be joined together by the same callus, which in some respects form a better covering or defence to the brain, than the flesh that grows up after the bone has been cut out. But when the fever increases under the first treatment of the malady, the patient’s sleep becomes short, and interrupted or disturbed, the wound appears moist or watery, and does not fill up, swellings arise in the neck, great pains, and a loathing or loss of appetite attend and increase after this method, then the hand must have recourse to the scalprium.”

From

From hence it is evident, that the violence or malignity of the symptoms will indicate whether the part affected ought to be laid bare, or whether one may hope for a cure of the injured bone without the operation.

2. The cleansing here understood is either artificial, by which every thing is removed from the wound, which is found of such a nature, as not to be able to unite with the living parts, such as grumes of concretioned blood, fragments of bone, corrupted membranes, &c. or natural, when every thing is cast off by suppuration, which cannot unite and grow to the living parts, though they may in some measure adhere to them. And by both these methods the impediments to the healing of the wound are removed, and which will prevent its cure, so long as they remain in the wound.

3. In this place is meant the perforating of the bone with needles or small wedges, as mentioned in §. 252, not the perforating a skull by the trepan properly so called, which cuts out a round piece of the bone.

4. For the integuments will never grow again to the bone, so long as it continues bare: but it must be first covered over again with a new membrane, like the periosteum which was destroyed, which membrane sends vessels into the bone, and receives others returning from thence. But this is effected by perforating the bone with many small apertures, that the subjacent living vessels may have a free exit to elongate and renew the lost membrane.

5. When all these have been performed, which we have enumerated in the preceding paragraphs, the cure of the wound is then very easy, and may be effected in the manner we described in §. 245.

S E C T. CCLIX.

THE part is laid bare, 1. By incising the integuments down to the bone, in a straight course by the scalpel, or in a course angular, perpendicular, or crossing each other, dividing them cautiously in fractures and loose fragments, and choosing either one method of incision or the other, according to the nature of the injury and the parts affected. 2. By exactly separating the incised integuments from the skull, with a scalprum or scraping-knife. 3. By filling the wound with scraped lint.

After the condition of the wound and its consequent symptoms have made it evident, that the affected parts ought to be thus laid bare, that the whole surface of the wound may lie open to the hand and eye, that operation is then performed in the following manner:

1. The hair being shaved off with a razor, the extent of the parts injured must be examined with respect to adjacent sutures, muscles, tendons, &c. and when in the first place must be determined what kind of incision will be necessary; whether a longitudinal incision through the middle of the integuments will be sufficient, or whether two incisions are required, to meet in various directions, according as the greater or lesser surface of the bone is to be uncovered. For if two incisions meet so as to form an angle, the bone may be laid bare through the whole extent, which is included by the sides of that angle: but if one incision be made in a tangent line to the part injured, and the other be drawn perpendicularly through the middle of the affected parts to the former, it is very evident that this method will expose double the surface

face of the bone that the former did; or if the same perpendicular incision is continued so as to intersect the middle of the former, it is evident that four angles will be thus made, so that a surface of the bone four times larger will be thus exposed, than if the same incision met in a triangular form. This last is called a cruciform incision, which exposing more of the bone than any other, is therefore judged the most commodious by Celsus (a) *Quæ duabus transversis lineis litteræ X figuram accepit, ut deinde à singulis procedentibus angulis cutis subsecetur*: “Which consisting of two
 “transverse lines, takes the figure of an X, that the
 “skin may afterwards be raised at each of the projecting angles.” We have therefore here pitched upon an incision sufficient to expose the injured parts, now it is evident, that a simple incision will suffice when the part injured is so small, that it may be viewed by raising the lips of the wound only. But an angular incision is convenient, when the part injured is but small, yet larger than to be uncovered by a simple incision. But when a still larger space is to be uncovered, the incision may be made in the line of a tangent to the affected part, from the center of which may be drawn any other perpendicular incision through the middle of the affected parts. But when it is required to lay bare as much as possible of the bone, a longitudinal incision is made through the middle of the injured parts, which is intersected in its middle by another longitudinal incision added to the first; and thus by elevating the four angles of the divided integuments, the whole space may be uncovered, which is intercepted by these two incisions.

But the incision ought to be made with a sharp knife that is sufficiently strong, that the edge may not be easily blunted; for the skin of the cranium is hard and callous, and requires a pretty strong incision. The edge of the knife ought directly to touch the bone so that by raising the bone itself, the pericranium may

(a) De Medic. Lib. VIII. cap. 4. pag. 516.

be also divided at the same time, and by the same incision : (b) *Ne quid ex ipsa membranula, quæ sub cutè calvariam cingit, relinquatur : siquidem hæc scalpro terebrisve lacerata vehementes febres cum inflammationibus excitat* : “ Left any part of the membrane should be left on the bone, which immediately invests the cranium under the skin : for if that is lacerated by the scraping-knife or the trepan, it excites violent fevers and inflammations.” For unless the knife be strongly pressed against the skull, the pericranium will remain to be divided, after the integuments are incised. It is, indeed, true, that by this method the knife makes a scratch in the bone ; but this is unavoidable, and when the bone is exposed, this may be easily cured.

Since it is therefore necessary for the edge of the knife to be forcibly pressed against the bone, it is evident, that one ought first to make a cautious examination whether the cranium is so fractured, that a fragment may be by this means depressed, while the knife is forced against the bone, from whence the most malignant symptoms, and death itself might follow ; as we have been sometimes assured by sad experience. Therefore, when by feeling with the fingers every way we perceive some part loose, the incision ought to be so directed, as to avoid that place : yet it is sometimes very difficult thus to perceive where the bone is fractured, especially when the parts are violently contused and swelled into a large tumour.

Also in making the incision, care must be taken as much as possible to avoid the wounding of any considerable arteries which are distributed through the integuments ; as also to avoid the most considerable branches of nerves ; as for example, those which come out in the forehead above the orbit of the eye, &c. likewise to shun the muscles, tendons, sutures, &c. the disposition of all which we suppose known from anatomy.

2. The pericranium adheres very firmly to the skull, by the vessels, which it sends into and receives from the bones, as we observed before: so that notwithstanding the integuments and pericranium are divided down to the bone, they will still adhere to the skull by a broad surface, and therefore the pericranium must be separated from its cohesion with the skull, before the naked bone can be exposed to view. Sometimes by raising the angles of the integuments, the pericranium easily follows, and departs from the bone, especially when there is but a loose cohesion betwixt them, as is observable in the skulls of old people. But when its adhesion is more firm, as is often the case, then it is necessary to separate the pericranium from the skull very expeditiously, with a well polished ivory scalprum or knife, which will not be done without the severest pain, unless the patient be quite stupid or senseless, as often happens in violent wounds of the head. It is therefore to be wished, that younger Surgeons would make themselves expert in the operation, by frequently performing it on the heads of sheep, calves, &c, that they may be able to separate the pericranium by the scalprum from the skull with expedition; since it would be both cruel and dangerous to make these by a learner, on the skulls of living people.

3. After having separated the integuments, the flux of blood generally prevents the naked bone from being accurately viewed, so as to detect its injury; on which account, if the case is not very urgent, a farther examination is usually deferred to the next day, or at least put off for a few hours. But to prevent the parts lately divided from growing together again, which they are observed to do in a little time, soft and flat pledgets are to be interposed betwixt the raised integuments and the surface of the naked bone, which will prevent this accident; and when the hæmorrhage is over, and the pledgets removed, by elevating the divided integuments, the whole surface of the naked bone

bone will come into view. And thus will be formed, on the next day, a very large wound or opening, with little trouble, as Hippocrates (*c*) observes, who also directs a cataplasm of fine oatmeal boiled in vinegar to be applied, 'till it becomes very glutinous, in order to prevent any great inflammation. For these dry pledgets swell by absorbing the blood and other humours, and by that means dilate the wound, which is generally inflamed and irritated thereby.

S E C T. CCLX.

THE blood, matter, or corrupted solids and fluids in the wound, are to be absorbed by little sponges; the fragments, splinters, or scales of the bone, when small and freed from the membranes, are to be extracted, as they come into view, by a pair of plyers; or else to be first cut off with a pair of scissars; and this makes the artificial cleansing of the wound.

After removing the pledgets, and wiping off the blood or other foul matter which hinders the naked surface of the bone from being viewed on all sides, the next business is to examine whether any injury remains to be corrected or removed. But if neither contusion, fracture, nor fissure can be discerned in the naked bone, and there is also no reason to suspect that any humours are extravasated under the skull, so as to make it necessary to trepan the cranium in that part, then the wound made is to be healed up again. For it sometimes happens, that the most skilful Surgeons and Physicians may be mistaken in this respect, notwithstanding they concluded from evident signs that some injury lay concealed under the integuments now raised. There are many observations in authors confirming this possibility of a person's being deceived:

D d 3

and

and Hippocrates observes in the place cited (§. 254.) that sometimes the bone is fractured in a different part of the skull, from where the wound was inflicted : and in the commentaries on §. 254, there are some observations enumerated from the best authors, which prove that there is always some reason to doubt in these cases. It is therefore best to advertise the wounded patient, or his friends, that all the signs call for an apertion of the integuments to discover the latent injuries ; and yet the malady sought for may reside in a part of the skull very distant from the wound. And therefore a prudent Surgeon will always call in a Physician, or other Surgeons, to determine what is to be done in these cases by a general consultation ; and thus he will have witnesses that every thing has been done according to the rules of art, though the event does not answer the expectation.

But when it appears that the naked bone is injured, the general indication (§. 185. numb. 1.) directs to remove every thing that may impede the cure of the wound. The extravasated juices lodged therein will be easily absorbed by dry sponges and scraped lint ; but the bony fragments, splinters, or small scales separated by the wounding instrument, may be considered as so many foreign bodies, which may prove injurious by remaining in the wound, or at least will much impede its cure. But as it was observed (in §. 186, 187.), we are first to inquire whether it will be safer to extract or remove them, or to let them remain 'till they separate and are cast off spontaneously : for if the fragments of the bone are small and not contiguous with the living parts, there are no hopes that they may afterwards unite, and therefore they may be safely removed by proper instruments. But since the bone, uncovered of its periosteum, may be injured by the free access of the air, as was said in §. 250 ; therefore it is necessary for these fragments to be so conspicuous to the eye, as that they may be immediately extracted without any long search by these instruments.

struments. It will also be dangerous forcibly to pull off bony fragments yet adhering to the membranes; since the great pain thence arising, and the connection of the pericranium with the dura mater, especially about the futures, may produce the most malignant symptoms; and therefore it will be better to cut them off first with a pair of scissars, if they are to be extracted.

But the cleansing of the wound, which is thus procured, either by the hand or instruments, is termed artificial, to distinguish it from that which follows from a spontaneous suppuration, and is therefore termed natural.

S E C T. CCLXI.

SUCH of these fragments as are very large, inscrutable, and still cohering to the living parts, are to be left in the wound; for they will either separate of themselves, or grow again to the living parts. And this is the natural cleansing of the wound.

But if there are very large fragments of the skull, enquiry must be made whether there is no probability of their uniting again with the bone; and this may be known especially by the alteration of colour: for if such a fragment appears yellow, brown or black, it will not unite, but will either separate afterwards spontaneously, or ought immediately to be removed, if possible with conveniency. But when these fragments look of their natural colour, and especially if at the same time they adhere to the pericranium, there is then great reason to suspect they will unite again. It sometimes happens in the larger sort of fractures, as in the tibia and femur, that the bone is broke in two places, so that the middle part is loose and divided from each end of the bone; and yet it has been fre-

quently observed, that such a fragment has united and grown again to the rest of the bone; whence it is evident, that we ought not to despair of the like success in similar fractures of the cranium. This fact is incontestable from chirurgical observations. A man received such a violent blow with the iron-shoe of a mule upon his forehead, that the os frontis was thereby fractured and depressed: a round piece of the skull was therefore cut out by the trepan, in order that the fractured and depressed parts might be conveniently elevated and removed; but the fracture extending from the middle of the forehead to the lesser canthus of the eye, Parey durst not remove so large a portion of the bone, but he elevated its parts so, that they no longer compressed the dura mater, by which method the wounded patient was happily cured (*a*). In like manner a fragment of bone which was entirely separated from the rest of the skull, but adhered to the pericranium, grew again to the rest of the parts. A certain captain had a large portion of the os frontis cut off with a sword, to about the length and breadth of three fingers, insomuch that the dura mater was quite laid bare. So large a portion of the bone, yet adhering to the pericranium, being folded back upon the face, made a frightful spectacle; and made Parey think of cutting it quite off: but fearing, lest the dura mater should be injured by so large a wound, after wiping off the blood from the dura mater, he again adapted the divided bone and integuments, fastening them by a slight suture in three places, so that they could not be easily distorted. The happy success of this practice was such, that it may serve as an example how much we may expect from the same in similar cases, since so large a part of the bone entirely separated, grew again in its place, though the man had several other bad wounds in different parts (*b*).

So

(*a*) Les Oeuvres d'Ambroise Paré, Liv. X. chap. 6.

(*b*) Ibid. chap. 7.

So long therefore as these fragments adhere to the living parts, it seems adviseable to let them remain; since there is some hope that they may again unite with the rest of the bone: but if this does not succeed, and signs make it evident that the separated fragments begin to corrupt, they will always either be cast off spontaneously, or may be removed by art. Whence also it is evident, that it is injurious to be too exact in examining wounds of the head, in order to remove the bony fragments, which do not immediately come into view; since if they adhere to the adjacent living parts, they may again unite, or will be afterwards cast off spontaneously, if they cannot unite; and that nature is often of herself sufficient for the cure in these cases, may appear from the following history. A girl of about nine or ten years old received, among other wounds in her body and arms, about eighteen cuts in her head, all which entered the skull, and some parts of the bones were cut off down to the diploë; and in other parts some of the skull was cut off close to the dura mater: the parts thus miserably wounded were dressed with a proper apparatus, which was renewed only every two days. In every dressing fragments of the bone came easily away, adhering to the pledgets; and those fragments yet adhering to the pericranium, grew again to the bone, and the spaces were readily filled up, where portions of the whole skull were cut off close to the dura mater, so that in the space of five weeks this girl was cured of so many dangerous wounds (c). But in this case there was no artificial cleansing of the parts, but all such as would not unite came away spontaneously by suppuration.

It is therefore a most prudent piece of advice given us by Hippocrates, when he says: (d) *Quæ vero ossa intus subsederunt à naturali suo statu, fracta aut late omnino præcisa, minus hæc periculosa sunt, si membrana integra fuerit: Et rimis pluribus Et latioribus intus confracta*

(c) Belloste Chirurgien d'Hôpital, pag. 82.

(d) Hippoc. de capit. vulner. cap. 28. Charter. Tom. XII. pag. 126.

fracta minus periculosa sunt, & facilius eximuntur; neque quidquam horum sectione (serræ) indiget; neque cum periculo tentandum est ossa auferre, priusquam sponte sursum cedant, &c. “That such fragments of the bones
 “ as are removed from their natural site within the
 “ parts, or such as are wholly cut off or separated by
 “ fracture, these are less dangerous when their perio-
 “ steum remains whole: and such bones as are frac-
 “ tured inwardly with many and broad fissures, are but
 “ little dangerous, and are more easily removed; nor
 “ do any of these require to be cut off by the saw;
 “ nor ought any one dangerously to attempt the re-
 “ moval of such bones before they rise up and sepa-
 “ rate of themselves, &c.”

S E C T. CCLXII.

IF the contused bone appears white, brown, livid, or split, it must be perforated with several little foramina as before directed (in 252); for by that means the living parts will speedily grow up, and the dead will be soon cast off or separated.

Sometimes it happens that after raising the integuments, no fracture can be found, and yet the bone is injured; and this is observed chiefly to happen when the wounding instrument is obtuse, or when a man hits his head a violent blow, by falling from on high on a flat pavement: for in these cases, the skull is fissured while the integuments frequently remain intire; else the pericranium is so contused betwixt the hard or resisting skull and obstacle, that its vessels are ruptured and torn off, which ought to convey the blood and juices from the pericranium into the bone, and from the bone into the pericranium; whence all the vital influx or circulation will be destroyed in the lamella of the skull next the pericranium. It is also sufficiently

sufficiently evident, that the vessels running betwixt the plates of the skull, in the diploë, may be likewise injured by the same causes, whence the disorder will become much worse. But when this contusion and destruction of the vessels is present in the skull, it may be known by the change in the colour of the bone: for a sound and living bone looks of a reddish colour, or of a pale blue; because the blood-vessels exhibit that colour, by being seen through the white lamella of the bone, which is thin and pellucid. Therefore in all places where the vessels are destroyed by contusion, their incumbent lamellæ of the bone will appear white; and hence (as in §. 255. numb. 6.), the appearance of the bone beset with white specks, is reckoned among the signs of a diseased skull: and Belloste (*a*), after having perforated the skull, naked of the pericranium, with several small foramina, remarks, as one of the first signs of success, that the bone began to look reddish; which is an evident token that the bone now begins to recover its vitality, though it was before deprived of the vital influx of the humours. But when the bone, whose vessels are destroyed, begins to corrupt, then its colour changes from white to yellow, brown, livid, and at last quite black; denoting a greater degree of corruption, as it recedes more from its natural colour, as we observed before in the comment on §. 249.

Since therefore there is danger in this case, lest the corrupted part of the bone should infect the next sound lamellæ, and penetrate into the diploë, from whence it might spread into the internal table, and affect the encephalon, especially when the extravasated and corrupted humours are confined from being discharged betwixt the two plates of the skull; all this evinces the happy use of the method before described (§. 252.) in which, namely, the bones of the skull are perforated in several parts, with distinct foramina to discharge the corrupted juices, and give the subjacent
living

(*a*) Chirurgien d'Hôpital, pag. 76, 78,

living vessels an opportunity of growing up and casting off the foul or deal scale of the bone. For that the separation of the foul bone is only to be expected from the action of the subjacent living vessels, Hippocrates (*b*) has long ago informed us; for after observing that bony fragments are not so forcibly extracted without hazard or danger, unless they yield and come away of themselves, he says: *Sursum autem cedunt, carne subnascente; subnascitur autem ex diploë ossis, & ex sano (osse), si superior tantum ossis pars corrupta fuerit*: “That they arise or exfoliate by the flesh that
 “grows underneath; but that flesh arises from the di-
 “ploë of the skull, and also from the sound bone,
 “when the upper plate only of the skull is corrup-
 “ted.” Thus did Hippocrates learn from observation only, what the industry of the Moderns has since confirmed, who have also used the same expression to denote the vascular compages which regenerate the lost substance in wounds. And it is wisely added by him, that this flesh grows out of the diploë in which vessels are so manifestly distributed; and also, that when only the upper lamellæ of the bone are corrupted, then the like flesh grows up not from the diploë, but from the subjacent sound bone, as he openly declares.

Even in fissures of the skull this same method will be equally serviceable, for all the disorders following a fissure, result, chiefly from the rupture of the vessels which extravasate their juices; whence a corruption of the bone, and all the bad consequences that may thence follow. But the small foramina, with which the bone is perforated near the fissure, make way for discharging the extravasated humours, and for the elongation of the living vessels, to renew the pericranium.

But how speedily a cure may be performed by this method, even in very considerable injuries of the bone, may appear from the instances alledged in the commentary on §. 252, 253.

S E C T.

(*b*) De capit. vulner. cap. 28. Charter. Tom. XII, pag. 126.

S E C T. CCLXIII.

BY which means alone (262) is procured a speedy regeneration of the periosteum (252).

S E C T. CCLXIV.

AND then the remainder of the cure has been already described (in 245, 246, 247, 248, 253).

Of all these we have treated in the numbers here cited. And when the pericranium is once by this means renewed, then the remainder of the treatment may be managed, and in other wounds of the head, which affect the common integuments only.

S E C T. CCLXV.

FROM hence it is evident, why a narrow fissure of the skull is often more dangerous than a broad contusion (256).

All skilful Surgeons and Physicians agree in this, that a fissure in the skull is often attended with much more danger than a violent contusion, or even a fracture of its bones.

For a fissure is more difficult to discover, and often escapes the strictest examination 'till it is too late, especially when seated near the sutures, or when it splits the external table of the skull, without affecting the exterior plate, or when it invades the bone in a part distant from the seat of the wound itself. Add to this, that when the fissure appears visible to the eye, yet it often runs to a greater length than can be safely laid

laid open by raising the integuments. And that all these circumstances sometimes concur in these accidents, has been proved by the observations of indisputable credit, which are alledged in the comment on §. 254. But when a broad contusion or wound of the bone happens, it sufficiently manifests itself, and the formidable appearance of the disorder excites the Physicians and Surgeons to use all the assistances of art, to prevent the bad consequences threatened. But a fissure lies often so concealed, that by affording no signs for its discovery, it may often deceive even the most skilful, as Hippocrates himself ingenuously confesses.

Another reason for which fissures are esteemed dangerous, is the uncertainty of knowing how deep they penetrate, whether into the diploë or deeper. If the fissure of the skull extends into the diploë, there will be very considerable vessels wounded; and the extravasated humours will not be able to discharge themselves through the narrow fissure of the bone, whence they will corrupt and destroy the tender cellular part of the bone which constitutes the diploë, and by the gradually spreading of the malady betwixt the two tables of the skull, it may corrupt them also: and when once the internal table of the skull is eroded, the encephalon may be affected, so as suddenly to destroy the patient, at a time when it is thought there is no latent danger; but after death the whole bone is found corrupted. Many instances of this nature are to be met with in the writers of observations. But in considerable fractures of the cranium there is a passage afforded to the extravasated humours, or at least one may be made by art; so that the subjacent living vessels may separate and cast off every thing that is corrupted: and hence it is, that the most grievous wounds of the head, attended with considerable injury of the bone, are often happily cured; when a slight fissure, by lying too long concealed, frequently takes off the patient suddenly, when no danger is expected. Hence

Hippocrates (a) boldly pronounces : *Si os (calvaria) fractum fuerit & contusum, periculo caret, &c. si vero fissum fuerit, & fissura intro procedat admodum est periculosum* : “ That if the skull is fractured and contused, it is not dangerous, &c. but if it is fissured, and the fissure runs inwards, the case is exceeding dangerous :” and adds, that the saw must then be used, lest the matter penetrating through the fissure should corrupt the meninges. And in another (b) place he affirms, that the bones of the skull being fractured and largely wounded, or divided with many and wide openings, are less dangerous : also that the skull can never be fissured without more or less contusion (c) ; whence a greater number of the vessels running thro’ the substance of the diploë, will be ruptured and destroyed, and thus will increase all the symptoms.

S E C T. CCLXVI.

AND it is hence also evident, that this method (252, 262) is preferable either to the cauterization, scalpra or trepans used by the Ancients in these accidents (249, 254, 256, 262.).

From what has been said in the comment on §. 252, it is evident, that a gentle terebration of the skull, with many small foramina, is a speedy and safe method of remedying these disorders ; whence it seems deservedly to be preferred to other methods. And though there is some appearance of this practice to be found in Hippocrates, as we before observed, yet the use of scalpra has been very frequent to abrade the diseased part of the bone. But from duly weighing all the consequences which must necessarily follow from

(a) Hippocr. de locis in homine, cap. 12. Charter. Tom. VII. pag. 371. (b) Hippocr. de cap. vulner. cap. 28. Charter. Tom. XII. pag. 126. (c) Ibid. cap. 6. Charter. Tom. XII. p. 118.

from such an abrasion of the bone, it will be evident, that this method of cure is both less safe, and more slow or tedious. Some Surgeons have, indeed, recommended cauterization with a hot iron, to separate the corrupted part of the bone : but I do not remember to have found any mention of this practice for diseases of the skull, either in Hippocrates or Celsus ; and at best, it must be very difficult to cauterise the diseased part of the bone without injuring the subjacent part which is sound ; for which reason the sound but adust part must be again exfoliated, before the cure can be expected.

But when any narrow fissure appeared in the bones of the skull, or any scratch or impression of the instrument, they then used scalp-ra of various sizes and figures, according to the magnitude and form of the injury ; and with these they rasped or scraped the bone 'till the impression of the instrument disappeared. And that they might be certain they had thus taken out the scratch or cut made by the instrument, they first coloured the naked bone with writing-ink, or with some other black liquor, as mentioned in §. 255. numb. 4. that the coloured liquor by penetrating into the division of the bone, might demonstrate how far or how deep it extended ; and they continued scraping 'till all the black mark was effaced. But when the division of the bone ran very deep, so that it could not be removed by scraping, they then used the terebra or old trepan to cut out a large piece of the bone (a). And when a large portion of the skull had been injured by contusion, and signs made it evident that the bone was corrupted, they then used what they called the exfoliating trepan, consisting of two wedges fixed in opposite directions, by turning round which they abraded the surface of the skull in an orbicular form. But as the surface of the skull is convex, and in many places unequal, it is very evident, that

(a) Hippocrat. de cap. vulner. cap. 23. & 24. Charter. Tom. XII. pag. 124, 125.

that the diseased part which is thus abraded cannot be taken down equally: and even after the impression in the bone is thus removed, either by the scalprum or exfoliating trepan, even then the surface of the abraded bone will be mortified by the destruction of its vessels; and therefore it ought to be separated or exfoliated before the pericranium can grow over it again. From what has been said, therefore it is evident, that little advantage can be expected from these methods of practice: and that by the method proposed in §. 252, we obtain a happy separation of the foul part of the bone, and that the lost substance and pericranium will be regenerated by the same means in a short time.

S E C T. CCLXVII.

TH E bones of the skull being thrust inwards in infants, or indented after a fracture in adults, the brain is thereby compressed; and according to the different parts of the brain thus pressed, with the size, depth, and sharpness, or pricking of the depressed bones, is produced either a stupidity, deep sleep, vertigo, tinkling in the ears, dimness of sight, and delirium, bilious vomits, pains in the head, convulsions, palsies, an involuntary discharge of the urine and fæces, apoplexies, fevers, and death.

After having spoke of the disorders which follow injuries in the bones of the skull; it now follows that we consider the consequences of a depression of the skull, or a thrusting of them inwards after a fracture, so as to compress and injure the contained encephalon. It appears from geometry, that a circle has the greatest area of all figures, having equal sides; but the shape of the skull approaches that of a sphere; and

therefore when the cranium is depressed, its capacity will be diminished. It is also well known from physiology, that the cavity of the skull is always exquisitely full in a state of health; insomuch that after cutting out a piece of the cranium, the contained encephalon immediately protuberates, so that the piece of bone cannot be placed in its former situation unless forced. It is therefore evident, that when the figure of the skull is changed by a depression, its soft contents must consequently be compressed.

But whether the convex figure of the skull is changed by a depression of its bones without a fracture, or whether the bone is also fractured as well as depressed, the effect will be the same, namely, a compression of the contained brain. We are persuaded, from the softness of the skull in infants, that a depression of its bones may be made in them without a fracture: whereas in adults the hardness of the bones is so great, that a depression is scarce possible without a fracture. Hippocrates (a) reckoning up the several kinds of fractures of the skull, places those by depression (*per ἐσφλασιν*) in the third place, and says, they are always attended with fissures; *Quo enim introprimitur, ab alio osse naturaliter se habente abruptum fractumque introcedit; itaque sane huic intropressioni rimam accedere necesse est*: “For what is depressed
 “recedes inwards from the rest of the bone, which
 “keeps its natural situation; and therefore in reality
 “this depression must of necessity be accompanied
 “with a fissure.” But the substance of the bones in a living body is much softer than in a dry skeleton; whence it may not be altogether impossible for the skull to be depressed in adults who are not decrepid; without a fracture or absolute separation of the parts.

But since the whole life and humanity of a person entirely depends on the contents of the cranium, and as the whole encephalon is soft and easily compressi-

ble;

(a) De capit. vulner. cap. 8. Charter. Tom. XII. pag. 118.

ble; it is evident, that a depression of the skull may disturb, or even abolish all the functions depending on the sound state of the encephalon. But as the cerebellum is more firm in its substance, and more securely lodged than the brain itself; hence it almost constantly happens, that a depression of the skull first injures the actions of the brain, and afterwards invades the actions of the cerebellum, on which life more immediately depends. It is also evident, that the effects or consequences of a depression may be very different, according as different parts of the brain are compressed, and as the compressing cause acts with a greater or less force; or as a sharp fragment broke off from the bone may wound the substance of the brain itself, more or less deeply. Also a slight compressure of the brain may disturb its actions, as appears from an experiment in a woman, who had half the bowl part of her skull taken off, which she carried from door to door begging money: if any body did but slightly press the finger on her dura mater, she screamed out, and said she saw a thousand candles (*b*). But the symptoms which follow from a compression of the encephalon as the cause, are enumerated in the following paragraphs.

Stupidity or dulness.] Which may follow barely from a slight compression of the brain. All those are observed to be first invaded with such an unusual dulness of all the senses, and aversion to exercise or motions of the muscles, who are afterwards taken with an apoplexy from a cold and slow cause. If then the skull be any how indented so as to compress the brain, it will produce the like stupidity, which will sometimes remain during life, if the compression is not removed. Such an instance we have in Hildanus (*c*), of a lad ten years old, of a happy ingenuity, but receiving a depression in his skull by accident, near the lamboidal future, without any bad symptoms immediately

E e 2

(*b*) Acad. des Sciences l'an. 1700. Hist. pag. 57.

(*c*) Observ. Chirurg. Centur. III. Observ. 21.

diately following, the case was neglected by his parents, and the depression became permanent: but by degrees the memory and intellectual faculties of this lad grew worse, so that he could learn nothing, and lived in that manner quite stupid, 'till he was forty years old, and then died of the plague. - A like dulness is also observed when too great a quantity of blood over-distends the large blood-vessels in plethoric people; or in acute diseases, where the vessels are thus over-distended by an increased velocity and rarefaction of the juices, so that the soft and pulpy substance of the brain begins to be compressed thereby.

Sleepiness.] Which denotes that the compression of the brain is more increased than before: for so soon as the causes which produced dulness or stupidity are increased, a sleepiness arises, and at length a most profound and fatal sleep, namely, an apoplexy. Whence it is that Hippocrates reckons a deep sleep and a vertigo, with darkness, among the signs which denote wounds of the head to be dangerous (*d*).

Vertigo, and dimness of sight.] A vertigo is almost the slightest of all disorders of the brain, and the greatest part, if not all disorders in the head, begin with it; and in their cure, they generally leave a vertigo as the last symptom. In every vertigo there is generally an apparent rotation of the external objects near us, though they are actually at rest; and sometimes the things seem to be tumbling down from on high, or the reverse. When the disorder increases, objects begin to appear variously coloured, and soon after follows a vacillation or incipient inactivity of all the muscles; then the patient thus affected being afraid of tumbling, lays hold of any thing that offers, to support himself; but the body becomes in an instant so weak all over, that the patient falls down, his sight wholly vanishes in the most obscure darkness; and this

(*d*) De capit. vulner. cap. 15. Charter. Tom. XII. pag. 121.

is the last symptom of which they are sensible: for if the disorder continues, it terminates either in a delirium, epilepsy, or apoplexy.

The slightest vertigo is therefore when the objects appear turning round; but the disorder increasing, a scotoma ($\sigma\kappa\omicron\tau\omicron\delta\iota\upsilon\sigma\mu\alpha$) or vertigo with darkness follows, and the patient thus affected tumbles down. These three different degrees of this disorder are remarked by Hippocrates, when he enumerates the signs of desperate wounds in the head: *Si tenebræ circumfundatur, & vertigo, vel & ceciderit*: “If darkness is spread round the patient, a vertigo takes him, or he tumbles down.” When Antilochus wounded his enemy in the forehead, so that the point of his spear entered the bone, Homer wisely says, that his eyes opened in darkness (e).

A simple vertigo therefore denotes only a slight compression of the brain; but a dark vertigo shows an increase of the disorder: and upon removing the compressing cause, both of them disappear. Hence it is, that when the larger blood-vessels are over-distended by the too great quantity or impetus of the blood in acute diseases, the brain is compressed, and a vertigo with darkness follows, which is removed by a bleeding at the nose, as Hippocrates observes in his *Prænotiones Coacæ* (f): *Tenebricosas vertigines ab initio sanguinis è naribus fluxus solvit*: “That dark vertigos are in the beginning carried off by a bleeding at the nose.” This he says, to distinguish it from a like vertigo, which does not arise in the beginning of the disease, but often creeps on slowly, from a morbid corruption of the bile, or other foul humours in the disease collected about the præcordia.

Tinkling in the ears.] A dark vertigo is almost constantly attended with a troublesome noise in the ears, as if they heard the jingling of a thousand little bells; and when this is occasioned by an internal cause,

E e 3

(e) Τὸν δὲ σκότῳ ὅσῳ ἐκάλυψεν. Iliad. Lib. IV. ver. 74.

(f) Numb. 341. Charter. Tom. VIII. pag. 871.

cause, without any external violence, it is called a *tininitus aurium*, or tinkling in the ears. This sometimes arises from a fault in the organs of hearing themselves, even a slight disorder in them; and in this case it is speedily removed by putting the little finger in the ear, and agitating it there, or by compressing the tragus of the outer ear; nor is it then any bad presage. But when it arises from a disorder in the brain itself, it is not then easily removed, but often continues to trouble the patient for years: and denotes a future apoplexy or epilepsy, as we are told in the *Prænotiones Coacæ* of Hippocrates (g). This symptom acknowledges the same cause with a vertigo, and is almost constantly an attendant in the more violent injuries of the head.

Delirium.] We know from physiology, that the brain is the organ on which depends the distinct perception of our ideas, the combination of them and the judgment thence resulting, with the passions of the mind, &c. but when the ideas which arise in our minds, do not proceed from external causes, but result from an internal change in the brain, a person is then said to be delirious. Now a compression of the brain from an indentation or change in the figure of the skull, may disturb all the actions in the body, which depend on the free state of this organ. For it is a common observation, that those who are changelings from the birth, have some defect in the figure of their skull; and Hippocrates, after reckoning up the dangerous symptoms which follow injuries of the skull, adds at last, that if great care be not taken they die delirious (h). And elsewhere he frequently condemns a delirium in wounds of the head as a malignant sign. *Æt plaga in caput accepta stupor aut delirium malum* (i). *Ab osse percisso delirium, si in vacuum penetraverit, &c.* (k):

“ That

(g) Numb. 161. (h) Hippocrat. de capit. vulner. cap. 31.
 Charter. Tom. XII. pag. 127. (i) Idem. Aphor. 14.
 Sect. 7. Charter. Tom. IX. pag. 298. (k) Ibid. Aphor. 24.
 Sect. 7. pag. 303.

“ That a stupidity or a delirium from a wound in the head is a bad sign.” And “ a delirium will arise from a wound in the skull penetrating its cavity, &c.”

Bilious vomits:] This is a wonderful symptom, which attending wounds of the head, always denotes that the brain is injured either by compression or concussion. For it is evident from the most certain and daily observations, that considerable alterations or disturbances in the brain, even of the most healthy person, will not only excite these bilious vomits, but also frequently produce a considerable alteration in the nature and appearance of the bile itself in a very short time.

A person not used to the tossings of a ship at sea, has green bilious vomits, after having suffered a vertigo and extreme anxiety: the same will likewise happen to a man in health, who is suddenly whirled round for a time: and here also the vertigo preceding denotes the brain to be affected. On the other hand, corrupt bile lodging about the præcordia may wonderfully disturb all the actions of the brain, and excite vertigos, convulsions, deliria, &c. but upon discharging that collection of bad humours, all the symptoms disappear. From whence it is evident, that a wonderful consent of parts obtains betwixt the head and the præcordia, so that they mutually affect each other very powerfully: nor can this be readily explained by all our knowledge of the structure of these which we at present possess; but that the fact is certain, appears from daily and incontestible observation. Hence too it is that Scultetus makes observation, that almost all who have received wounds in the head complain of a bitterness in the mouth (l).

This has been always a sign much suspected in wounds of the head: whence Hippocrates, *Quibus cerebrum vulneratur, febris plerumque ac bilis vomitus accedit, & corporis sideratio, & tales perniciose habent* (m).

E e 4

Quibus

(l) Sculteti Armament. Chirurg. pag. 198. (m) Hippoc. in Coacis Prænotion. Num. 500. Charter. Tom. VIII. pag. 881.

Quibus perscissum fuerit cerebrum, necesse est his febrem & bilis vomitum supervenire (n). Bilis vomitus vulneri succedens, malum: & maxime in capitis vulneribus (o):

“ In those who have the brain wounded, a fever and
 “ bilious vomits generally attend, with an apoplexy
 “ and the like malignant symptoms. In those who
 “ have the brain wounded, a fever and bilious vomit-
 “ ings must necessarily follow. Bilious vomiting,
 “ after a wound, is a bad sign; and especially after
 “ wounds in the head.” And even when the brain
 begins to be compressed from internal causes, or to be
 any other way disordered, bilious vomits, especially
 of a green colour, or like that of leeks, are reckoned
 among the malignant symptoms. *In capitis doloribus æruginosi vomitus, cum surditate & pervigilio, cito ve-*
hementer insanire faciunt (p): “ Green vomitings in
 “ pains of the head, with deafness and restlessness, or
 “ watchings, soon cause the patient to become vio-
 “ lently delirious,” And the truth of this sentence
 he confirms in the case of Philistes (q), in the epide-
 mics, in whom all those symptoms arose in the fore-
 mentioned order; but on the fifth day he expired.

It is therefore evident, that bilious vomits often
 follow injuries of the brain, as well from internal as
 external causes. But this ought always to be ob-
 served, that since bilious vomitings often follow slight
 disturbances of the brain, it should not be constantly
 exclaimed as a malignant sign, unless other bad symp-
 toms attend at the same time. For it often happens,
 that if a man falls down from a high place, and hits
 his head against some hard body, he shall be troubled
 with vomitings barely from the concussion of his brain,
 without any other worse consequence. For in the case
 lately mentioned, in §. 258, from the observations of
 the

(n) Hippoc. Aphor. 50. Sect. 6. Charter. Tom. IX. pag. 283.

(o) Idem in Coacis Prænot. Numb. 507. Chart. Tom. VIII. p. 882.

(p) Hippoc. Proorrh. Lib. I. Prædict. 10. Charter. Tom. VIII.
 pag. 706. & Coac. Prænot. Numb. 170. ibid. pag. 861.

(q) Hippoc. Epid. 3. agrot. 4. Charter. Tom. IX. pag. 232.

the celebrated Ruyfch, after the woman had fallen out of a carriage upon the hard frozen ground, when the Surgeon understood that she had vomited several times, suspected that there was some bad contusion in the os frontis, which he was therefore going to lay bare by a crucial incision, if he had not been prevented by the consulting of Ruyfch, who soon removed all the complaints, by applying fomentations to the head.

Pains of the head.] Whether the substance of the brain or cerebellum itself, when disordered is susceptible of pain, does not appear from experiments. It is certain the cortical substance of the brain may be injured without producing any pain; and we likewise know that it may be safely extirpated, when it degenerates into a fungous excrescence. But injuries of the medulla we know do excite convulsions, and then all the faculties are so disturbed, that we cannot determine whether any pain also attends. In the mean time it is evident, that the exterior integuments of the skull, especially the pericranium and its incumbent tendinous expansion (of which we spoke in §. 239.), as also the periosteum internum, or dura mater, are all highly sensible of pain after injuries: whence some celebrated Physicians have formerly pronounced, that a head-ach is a disorder essential to the brain and its integuments, as a delirium is to the brain (r). Since therefore an indentation of the skull, or a depressure of it after a fracture, cannot happen without injuring, or at least distracting its integuments, and the dura mater itself, it is very evident that pains of the head must follow such accidents, unless the encephalon is so compressed at the same time by the introcession of the bone, that all the senses are thereby totally abolished. And therefore a pain of the head in these cases, may be no bad presage, denoting that the functions of the brain are not totally abolished.

Convulsions.]

(r) Lud. Duretus in Coacas Prænot. Hippocrat. pag. 87.

Convulsions.] Which almost constantly denote that the brain is so compressed or injured, as to disturb the equable influx of its spirits into the nerves, subservient to the motion of the muscles; of which we spoke before in §. 230. and the following.

Palsies.] That is when the brain is so compressed or injured, as wholly intercepts the flux of spirits by the nerves into the muscles: and this disorder is variously denominated according as the actions, either of all the muscles, or those of one side only, or but of some one particular part of the body are destroyed, as we shall presently declare more at large. For the effect of this compressure will be different, according to the particular parts of the brain on which it is made. But a palsy is always a bad sign when it follows in wounds of the head, because it denotes that the very medullary substance of the brain is injured or compressed.

A spontaneous discharge of the urine and fæces.] From a palsy or relaxation of the sphincters of the bladder and anus: and this is esteemed one of the worst signs both in diseases and in wounds of the head. For the nerves subservient to these sphincters, arise from the nerves of the spinal medulla, which pass out thro' the foramina of the os sacrum; whence it evidently follows, that the spinal medulla itself must be injured at its origin in the brain. But we ought to distinguish betwixt this paralyfis of the sphincters of the bladder and anus, whereby the fæces are slowly and constantly discharged, and that which happens in apoplexies and acute inflammatory disorders of the head, where the urine is first collected to a considerable quantity into the bladder, and discharged perhaps once in every six or more hours; this last, indeed may happen unknown to the patient, but yet without a palsy of the sphincter of the bladder, because the urine was so long collecting in the bladder, 'till then strictly closed.

It is a much worse symptom for the urine to escape continually, as well as insensibly, after a relaxation of the sphincter of the bladder, than if it was first collected to a considerable quantity before it was let loose, without the cognizance of the patient. For this last accident very often happens to children who are well in health, and sometimes even to adults, without any bad consequences attending it. And this distinction seems also to have been made by Hippocrates, when he says, (f) *Urinæ non recordantibus emissæ perniciosæ; num & ab his mejuntur, ac si sedimentum conturbaveris:* “It is a very pernicious symptom for the urine to be discharged unknown to the patient; and possibly the same consequences may be feared hence, as after a disturbance of the crisis or sediment.” Here then he would have very bad consequences feared; because it denotes that the brain is oppressed. But in another place he says, (t) *Quibus urina clam elabitur ad pudendum, exsolvuntur desperati* (ἐνέλπιστοι). For thus Foësius (u) would have us read this passage, though the common reading of the text has it, *Quibus clam urina decidit, & pudendum contrahitur, desperati sunt:* “Those are desperate, whose pudenda shrivel up, and urine comes away unknown.” Cornarius reads ἐλκονται for ἐκλόνται, and Duretus (w) is of the same opinion with him. From whence it is evident, that the disorder is threatened to be much worse when the urine slips away insensibly from a paralysis of the sphincter of the bladder, than if it is discharged unknown to the patient, after having been collected to some quantity. Whence it is that Hippocrates (x), after having reckoned up the pernicious qualities of the urine as to its colour, consistence, contents, &c. he

(f) Prorrheticor. Lib. I. prædict. 28. Charter. Tom. VIII. pag. 718. & in Coac. Prænot. Numb. 590. (t) Coac. Prænot. Numb. 474. ibid. pag. 878. (u) Foësii Hippocrat. Opera omnia, pag. 193. (w) Lud. Duretus in Coacas. Prænot. Hippocrat. pag. 363. (x) Coac. Prænot. Numb. 580.

he then absolutely condemns any sort of urine that is voided unknown to the patient (λαθραίως ὄντα μὲνον).

Apoplexies, fevers, and death.] The symptoms or appearances which we have hitherto enumerated, denote that the actions of the brain are disturbed only by a slight compressure, or indentation of the skull; but when this compressure has been so far increased, as to abolish all the external and internal senses, with the voluntary motions, there is then the appearance of a profound or dead sleep, called an apoplexy; which is almost constantly attended with a strong and quick pulse, from the action of the cerebellum still remaining, or even being increased, because it lies better secured from the compressure by the processes of the dura mater; but when at length the cerebellum is also compressed, or its structure destroyed by the increased motion of the blood (for when the brain is compressed, and the blood denied a free passage through the encephalon, its force is almost entirely spent on the cerebellum), then death follows.

S E C T. CCLXVIII.

AND also, when the brain itself is thus injured, or corrupted in some parts by the inflammation, suppuration, a gangrene, fungus, hæmorrhage, or the like, it produces the same maladies (267).

The chief malignity of wounds in the head proceeds from their being so easily apt to injure the subjacent brain: if therefore the injury is such as to extend to the brain itself, it is very evident that the worst consequences are to be thence feared; since all our human faculties depend on the sound state of this soft and pulp-like viscus. In the mean time it appears from the principles of anatomy and physiology, that the whole encephalon is made up of vessels which

which being obstructed, compressed or injured, inflammation, and all the bad consequences thereof may follow; and also the like train of effects may proceed from the pressure of the extravasated juices, or from an erosion they produce when corrupted. That all these consequences follow injuries of the brain is evident, from chirurgical observations.

A man was wounded in the back-part of his head with a scymitar, which also divided the bone; this wound being first examined by an unskilful Surgeon in a careless manner, he thrust his probe for near a third part of its length through the division of the skull, into the substance of the brain; and therefore some more prudent Surgeons coming afterwards, would not permit the operation of the trepan, lest it should be disgraced, and deter others from its salutary use. After various symptoms, the unfortunate patient expired on the third day, and after opening the skull, a large abscess appeared on the left side of the brain, circumscribed in a cell or capsula of its own; by incising which a large quantity of foetid matter was discharged (*a*). Parray also testifies (*b*), that in examining the bodies dying of wounds in the head, to make his report to the judges, he has frequently observed a large quantity of matter, and even a suppuration in the substance of the brain itself. He also gives us a history that demonstrates a suppuration may be formed within the cavity of the skull, and the patient notwithstanding recover. A lad had so violently hit his head against a stone pavement, that he was immediately deprived of all sense: a fever, delirium, and other malignant symptoms followed. On the seventh day a copious sweat and sneezing appeared, and he discharged a large quantity of matter from his mouth, nose, and ears, to the great relief of all the symptoms; and the lad afterwards recovered.

We

(*a*) Scultet. Armamentar. Chirurg. pag. 217.

(*b*) Lîv. X, chapit. 23.

We have another wonderful instance (c), where a large quantity of matter issued from a small foramen in the sagittal future, after an injury of the skull from a fall; whenever this discharge of matter was suppressed for some days, the patient was then convulsed several times in a day, and when the matter discharged itself again, the convulsions ceased: at length the patient expired on the fortieth day. In the skull was found a broad fissure extending itself for near six inches in length, but it was then closed or consolidated; no disorder appeared in the dura mater, but the whole left lobe of the brain was suppurated, the right lobe and the cerebellum remaining untouched.

Many more of the like instances are to be found in the writers of observations; but these are sufficient to demonstrate, that a true suppuration may take place in the substance of the brain. And it is also from hence evident, that though a suppuration in this part is always very dangerous, yet it is not constantly fatal or attended with death.

But when instead of a mild suppuration (which divides those parts which admit not of the circulation from those which do) the brain is invaded with a gangrene, it is very evident, that in that case there are no hopes remaining. That such a gangrene of the brain does sometimes follow wounds of the head, is evident from observation. A soldier was taken into the hospital, who had received a violent contusion in his head without a wound; and after the space of nine weeks, when he perceived no more pain nor any other disorder, and was about to be returned as cured into his own country, he died suddenly in the night time as he lay in bed. Upon inspecting the body no injury at all appeared in the skull, but the substance of the brain, for about the thickness of a finger under the contused part of the head, appeared corrupted like a rotten apple, with an uncommon putrefaction penetrating almost into the anterior ventricles.

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all the other parts appeared sound, except a slight corruption of the pia mater (*d*). A man received several desperate wounds in his head, penetrating into the substance of the brain in the month of October, and in two days after he expired: upon removing the dressings after death, such a nauseous smell came from the wounds, that scarce any one could bear it, and hardly any body dared to approach the body (*e*). Such a malignant putrefaction did there arise in the small space of two days in a healthy man, at a season also sufficiently cool.

That a suppuration may be formed in the substance of the brain itself, is observed by Hippocrates, who calls it by the term σφακελίζειν. Thus he says, (*f*) *Cerebro corrupto, quidam in tribus, alii in septem diebus moriuntur: illas autem si effugerint, servantur: Quibus autem sectione adhibita os disjunctum apparet, hi pereunt*: “ That when the brain is corrupted, some expire on the third day, others on the seventh day; “ but if the patient escapes those terms he is secure: “ but even then, those where a division appears in “ the bone after incising the integuments, these “ perish.” And in his aphorisms, (*g*) *Quibus encephalon corruptum fuerit (σφακέλισθη) in tribus diebus pereunt, si vero has effugerint, sani fiunt*: “ Those who “ have corruption or mortification in the brain are “ killed within the third day, but if they escape that “ time they recover.” In these places he intimates, that a cure is even yet possible, though the encephalon be corrupted. It will appear hereafter, that the substance of the brain itself arising into fungous excrescences, may be securely cut off, or eroded, &c. not only without affecting the patient’s life, but also without injuring any of the functions of the brain.

It

(*d*) Sculteti Armamentar. Chirurg. pag. 207.

(*e*) Hildan. Observ. Chirurg. Centur. 2. Observat. 25. pag. 103.

(*f*) In Coac. prænot. Numb. 188.

(*g*) Aphor. 50. Sect. 7. Charter. Tom. IX. pag. 319.

It was said before in §. 158. numb. 5. that upon a division of the skin, the subjacent fat arises above the level surface of the wound, for want of the confining and equable pressure of the skin; and that it thus degenerates into a fungus, or proud flesh, in wounds. A disorder like this takes place in wounds of the head, when the skull itself and the dura mater have been divided. For naturally the skull is exquisitely full with the brain, as we observed in some places before; when therefore the contained encephalon or brain is no longer confined by the skull and dura mater, it begins to protuberate; and because the arteries deposit their elastic thick coats before they enter the substance of the brain, therefore they are less capable of sustaining the impulse of the blood from the heart, whence they will be very much dilated, and form uncommon tumours. And as these tumours arise very suddenly and unexpectedly, and expand to a considerable bulk, when they are surmounted the lips of the wound, being somewhat contracted or less in the mouth of the wound itself, therefore these tumours are from the similitude of their figure termed fungi, or excrescences of the brain. And the largest of all these fungi are formed, when the patient is taken with a violent fever; because the greater impetus and velocity with which the blood is then drove into the arteries of the brain, easily increases their dilatation. But such fungi are seldom formed while the dura mater continues entire; for this membrane being sufficiently strong, confines the subjacent substance of the brain. But when the pia mater is likewise wounded, as well as the dura mater, then the fungi of the brain protuberate still more than ever: for we see that even in a dead body, the soft cortical substance of the brain will immediately thrust itself out through a small wound in the pia mater.

We are furnished with many observations from surgery, by which it appears, that after dividing the cranium and dura mater, the substance of the brain will

will degenerate into a surprising excrescence or tumour; it may be sufficient for our purpose to relate one or two of these instances.

A noble youth had the right parietal bone fractured by a stone from a sling; hereupon the substance of the brain came out to the quantity of half a walnut: and when a certain young Physician present denied it to be the substance of the brain, saying it was fat, Parey proved by experiment, that the substance of the brain itself came out of the wound (*h*). This instance shows, that when the confining skull and meninges of the brain are wounded, its soft pulpy substance will immediately protrude itself and form a tumour.

A lad of fourteen years old was struck in play with a wooden ball on the left side of the os frontis: he presently tumbled down, had bilious vomits, and afterwards continued to bring up every thing which he took into his stomach. After two months, when he continued still in a very bad way, the skull was trepanned; a purulent matter immediately forced its way out through the opening, and afterwards the substance of the brain itself began by degrees to emerge, nor could it be confined; and therefore the luxuriant part was cut off, by tying a thread round it. Soon after a like fungous substance arose again to the height of three finger's breadth, which was again removed in the same manner. And this was so often repeated, that all the fungi together would equal the size of one's fist; yet the patient was afterwards cured (*i*).

A lad of seven years old received a violent wound upon the right parietal bone by a fall from a horse. On the fifth day a fungus grew out of the fractured bone, to the length of a thumb, and the thickness of a finger: the parents were unwilling to permit an accurate inspection of the wound, or to suffer an elevation of the depressed skull, and continually affirmed,

(*h*) Livre X. chap. 23.

(*i*) Hildan. Observ. Chirurg. Centur. IV. Observ. III. pag. 287.

they had rather their son should die with little pain than undergo the torture of a cruel operation, whose event was uncertain. Hence the Physician and Surgeon were obliged to use hardly any thing but desiccatives to remove the fungus. And thus the fungus continued almost unaltered for three whole months; but in the mean time, the symptoms which at first were very malignant, were now become very mild and almost removed: all the animal, vital, and natural actions of the body were restored, insomuch that the child grew lustier, and spent his time in play as usual. About the beginning of the fourth month the fungus increased very much; but was taken down by the aspersions of a powder, *ex euphorbio & alumine ustis*; but within the space of four and twenty hours another fungus grew up to the magnitude of a hen's egg, with an increase of all the bad symptoms. In this fungus was perceived a strong pulsation of the arteries, and by roughly handling, it bled very copiously. In vain was the reduction of this luxuriant fungus attempted by corrosives; and therefore the Surgeon tied a thread round the narrow neck of the tumour; but then there arose so violent a pulsation in the arteries of the fungus, that the whole body of it seemed to leap up. But this method of constriction by ligature was continued, and the greatest part of the fungus dropt off with the ligature, smelling intolerably. The remains of the fungus appearing black, sordid, and quite corrupted afforded a lamentable sight; and was followed with convulsions, tremblings and a palsy of one side. Yet did this corrupt part of the fungus separate in a few days after; but then another fungus of an ashy colour arose to the size of a walnut, without being painful, and a manifest pulsation was perceived in the arteries dispersed through the substance of this fungus, which emerging out of the wound, separated spontaneously in a few days, and left a large sinus or cavity behind in the substance of the brain. In two days afterwards the cavity was in one night's time filled with

a new fungus, and in a few days after, the miserable child being terribly convulsed backward for two whole days, then expired, in the fourth month after the wound was inflicted: but all the senses, speech, and reasoning faculties, continued even 'till death (*k*).

This surprising history teaches us, that such fungous excrescences of the brain are vascular, dilate wonderfully to a considerable bulk, and arise again very suddenly, even after they have been removed. In the body of this child it was observed, that the cortical part of the brain was quite consumed in the place wounded, and all its surface was covered with a deal of matter.

Hæmorrhage.] There are chiefly three kinds of blood-vessels in the encephalon, usually considered; 1. Those arteries which are dispersed through the dura mater, and which are sufficiently strong and tough, being secured by the duplicature of this membrane, and safely distributed: but that these are considerable arteries, may appear from the furrows or impressions which they leave in the skull: 2. The blood-vessels dispersed through the pia mater, which is altogether vascular, as we are taught by anatomical injections. But these arteries having deposited their thick coats before they enter the pia mater, are therefore very thin, and so the more easily injured. Now so soon as these blood-vessels are continued from the pia mater into the cortical substance of the brain, they do not then carry red blood, but a pellucid juice much thinner: for naturally there never appears any red blood in the cortical substance of the brain. 3. There are also blood-vessels detached among the medullary fibrils of the encephalon, and which are even conspicuous to the naked eye, and they administer a gentle warmth to the medullary tubuli or fibrils. The like and even pretty large blood-vessels also encompass the medulla oblongata. Also in the hollow ventricles of

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(*k*) Miscell. curios. Decur. II. anno 9. Observ. CLXXIV. pag. 321.

the brain are disposed those wonderful productions of the pia mater, which are termed plexus choroideus, which freely fluctuates within the ventricles of the brain without adhering to any part of them, and that this is altogether a compages of vessels, appears from anatomical injections, or even to the naked eye without the assistance of injections. In all those places then may these blood-vessels be distended or ruptured. so as to discharge their contained blood: and even when the wounding cause does not extend so deep as these parts, yet the very tender vasculæ in the pia mater and ventricles of the brain, &c. may be ruptured by a violent concussion, and their extravasated blood compressing the encephalon, may disturb and even totally abolish all the functions of the brain; as is evident from innumerable instances.

Whatever then be the cause which injures or compresses the brain, or either inflames, suppurates, corrupts, or destroys its structure, the same may produce all the bad consequences enumerated in §. 267, even from the slightest vertigo down to the most fatal apoplexy.

S E C T. CCLXIX.

THIS depression (267) is discovered by the touch, by inspection, and by raising the integuments (259).

All this is to be diligently enquired into at the first dressing of a wound in the head: for the same symptoms often appear in wounds of the head, when the parts injured are very different. Thus an indentation or depression of the skull, after a fracture, may by compressing the encephalon, produce all the diseases of the brain; and a like compressure, arising from blood extravasated from the vessels of the pia mater, will also produce the same diseases of the brain, whe-
ther

ther there be any injury of the skull or not; and therefore the first enquiry must be, whether the skull is injured. This is done by a gentle feeling of the affected parts on all sides by the fingers, in order to perceive whether the convex figure of the skull is altered in any part or not: but in this examination by the fingers great caution is necessary, since the touch is often fallacious, as we observed in §. 255. numb. 7. But when the depression of the skull is so large as to leave a visible cavity, there is then not the least room to doubt of it: and when the urgency of the symptoms is such as to call for an exposure of the skull, by raising its integuments, it will then be likewise still more easy to know whether the bone is thus injured or not.

S E C T. CCLXX.

THE cure is accomplished by removing the pricking splinters or fragments of the bone, by raising its depressed parts, and by preserving them in their natural situation.

The general indication for a cure consists in these three things. For it sometimes happens, that a fragment of the depressed bone injures the subjacent encephalon; and sometimes such an orbicular indentation is formed in the skull, especially when the blow comes from an obtuse and round obstacle, that the brain is compressed by indented parts, without being either pricked or lacerated. And sometimes again it even happens, that the external table of the skull remains sound, and the internal table at the same time flies off into fragments, which, by pricking and lacerating the subjacent brain, destroys the patient. Of this nature we have an instance given us by Parey (a). A nobleman, whose head was armed with a steel cap, received

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such

such a blow from a bullet as indented the steel cap, without causing any apparent injury in the external integuments, nor could any depression of the skull be observed; but yet he died apoplectic on the sixth day: upon opening the body his skull appeared broke into fragments, in the internal table of it, while the external table remained sound; and the fragments had penetrated the substance of the brain. And he says, that he observed the like case in another person, which he demonstrated to several of the chief Physicians, who were there present. The difficulty of detecting such a latent injury is very apparent: but if the case is discovered to be such, the greatest prudence is required for removing these sharp fragments, in order to avoid doing greater injury to the brain, by turning round, or violently agitating the fragments. But after the indented or depressed parts of the skull are raised into their natural positions, it is then necessary to retain them so, or prevent them from being displaced, as they easily may be, a second time. Thus the compressing cause being removed, the free circulation of the juices through the parts, now at liberty, will restore each to their natural uses: but art in this case only reduces the parts to their natural situations, from whence they were displaced.

S E C T. CCLXXI.

THerefore the naked skull (259) which is soft in children, is to be lifted up by a sticking plaster; or in the hard skull of adults, it is to be raised by an elevatory or screw: but when the depressed part being loose will not sustain the trepan, the skull is to be trepanned near the fracture, in order to raise the loose and depressed parts by a lever; the elevation will be also promoted by the patients sneezing and holding his breath,

A depression of the skull very seldom happens without a fracture, except in young children, where the bones being yet soft and pliable, may yield without breaking. But in order to elevate the skull depressed in these, Surgeons have contrived a method of raising the bone by forcing the integuments perpendicularly upwards. For in young children, the pericranium very firmly adheres to the skull by the vessels, which it sends into and receives from the bones: but as age advances, a great many of these vessels are by degrees obliterated, whence the pericranium is observed to cohere with a much less force to the bones of the skull in very old people. Since therefore the firmer adhesion of the pericranium, and greater flexibility of the bones in young skulls, may give one great hopes of elevating the depressed parts in this manner, therefore this method ought to be first tried, before recourse is had to a more difficult operation: at least, it can never be injurious to make trial first of this method; which is performed after a twofold manner. For some apply a cupping-glass to the place affected, and when it sticks fast, they suddenly pull it off perpendicularly upwards: thus all the integuments are drawn violently upwards, and at the same time they raise the depressed part of the cranium (*a*). Otherwise a piece of strong sticking plaster, of pitch or the like, is applied to the skin of the parts affected, so as to adhere firmly; and Hildanus (*b*) advises not to shave off all the hair, that the plaster may take the firmer hold; and he would also have the plaster not so large as to cover the whole surface of the depression, but to extend only to about a third part thereof, that the force may by that means be wholly exerted upon the parts indented. A string ought also to pass through the middle of the sticking plaster, by which the Surgeon is to make his evulsion,

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(*a*) Parè Livre X. chapit. 5. Hildan, Observ. Chirurg. Cent. 2. Observ. 5. pag. 83.
 (*b*) Ibid. pag. 83, 84.

sion, by pulling perpendicularly upwards, after the plaster has first taken firm hold.

But when this method has been tried without success, or when there are no hopes of success in adults, for raising the depressed parts of the skull by this artifice; in that case, after raising the integuments by incision, the Surgeon applies an instrument, called an elevator, to the naked bone. Various kinds of this instrument are described by the writers in surgery, the best of which seems to be those formed with a spiral screw, which is gently fixed into the middle part or center of the depressed bone, without pressing on it, or by turning it round with the hand suspended, and when it has once taken firm hold, it is drawn upwards with the depressed bone. Several of these instruments are figured, and their uses described, in Hildanus (*c*), Scultetus (*d*), Parey (*e*), and others. And Hildanus even tells us in the same place, that an expert Surgeon, being destitute of other instruments, successfully applied the spiral screw, commonly used by coopers for raising the heads of casks; and with this gross instrument he not only raised the depressed skull, but also extracted several fragments with it.

But though this instrument is to be applied with a suspended hand, yet some pressure is also required to make the screw enter the bone; and therefore if the depressed bone is loose, it will by sinking deeper be in danger of causing greater injury to the brain. In this case then another method is required: if the fissure is large enough to admit a lever, then the bone may be that way raised, provided you take care to support the turning point of the lever upon a sound part of the skull. But when there is no passage for introducing such a lever under the depressed bone, an opening must then be made by art; namely, by cutting out a piece of the skull, near the fractured and depressed

(*c*) Observat Chirurg. Centur. 2. Observ. 4. pag. 80. 81, 82. 83.

(*d*) Armamentar. Chirurg. tab. 3. pag. 9.

(*e*) Livre X. Chapit. 5.

depressed parts, with a trepan, by which the lever may be introduced to elevate the depressure; and if one such opening is not sufficient, more may be made with the same trepan. In a very large depression of the skull, Scultetus (*f*) tells us, that he has been obliged to make seven of these openings by the trepan, round the circumference of the depressure, and that even after this he was obliged to cut out the intermediate pieces of the bone betwixt each aperture, in order to remove all that was depressed, since they could not be elevated: and notwithstanding so dangerous an operation was performed, even sixteen days after the infliction of the wound, yet the man was perfectly cured, so that in about eight weeks after the soldier returned to his usual office.

Promoted by the patient's sneezing and holding his breath.] When a person is about to sneeze, he perceives a sort of gentle and agreeable tickling in the nose, and sometimes there is also the same sensation about the præcordia; when one or both of these are felt, the man is obliged to suspend all the bodily actions and wait the event, which the moment after is a convulsion of all the muscles subservient to expiration, which contracting suddenly, and with a violence not to be restrained, expel the air contained in the lungs with a considerable noise. That moment therefore when this violent expulsion of the air is made, the blood cannot pass through the lungs; and therefore the venal blood is obstructed in its return from the head, as it meets with a less free passage into the right auricle and ventricle of the heart, whence all the vessels of the encephalon will be distended at the same time, that the force and quantity of the arterial blood is increased by concussion of the parts; and from the concurrence of both these powerful causes, the whole mass of the encephalon will be forcibly distended. That things are in this state is evident, because upon a repetition of the sneezing, all the senses and

and the motions of the muscles begin to flag, the face swells, the eyes water, the nose drops; and if it still continues longer or returns oftener, the several functions of the brain are often wonderfully disturbed. But while the breath is held, the passage of the blood through the lungs will be also impeded by the expansion or rarefaction of the confined air, from the heat of the parts; whence the jugulars will not be able to empty their blood, whence will follow all the consequences mentioned from sneezing, only with this difference, that in sneezing the blood meets with a free passage through the lungs during the two sneezings; whereas in holding the breath, the compression or distention of the lungs is every moment increasing from the greater expansion of the confined air. If then the bones of the skull are as yet pliable in a young patient, or if they are so depressed in adults as to be easily moveable with a small force, then the encephalon becoming turgid from the retained blood, may raise the depressed part of the skull, or at least promote its elevation, especially when attempted also by other means at the same time.

And that the distending force, which the encephalon thus exerts to raise the depressed and confining skull, is very considerable, we are taught by a very remarkable instance. A girl of thirteen years old was struck on the head, by some slates falling off from a very high roof, which made so great a depression in the skull, near the meeting of the sagittal and coronal sutures, that it was four inches over. From the urgency and malignity of the symptoms, after opening a vein, the skull was immediately trepanned; but when the surgeon endeavoured to raise the depressed fragments, he found them all so divided from the adjacent parts, as made it necessary to remove them: Thus a large chasm remained in the skull, from the loss of so great a part of its bones; yet was this wound happily cured in the space of three months. The weak part of the head was afterwards defended with a plate of lead,

which the girl wore for two months, and then neglected, as fearing no farther danger; and in that manner she lived well for seven months. But unfortunately she was taken with the whooping or convulsive cough, which was then epidemical; and in the night-time, as she lay in bed, the fit strained her so violently, that it tore open the cicatrix of the late wound, and forced out above two ounces of the substance of the brain upon the scalp: she instantly became paralytic in all her limbs, but her speech and reasoning remained entire, and on the fifth day of this misfortune she expired (g). It is well known, that in this troublesome cough, the course of the blood through the lungs is so obstructed, that the patient often looks frightfully red, or even black and blue in the face; because none of the venal blood is evacuated, either from the external or internal parts of the head, into the right auricle and ventricle of the heart, the convulsed lungs being then full, and the left ventricle of the heart in the meantime continuing to urge the blood through the arteries. And by this means, the mass of the encephalon being highly distended, burst open the cicatrix of the wound, which had been cured above nine months. And from hence may appear, how great a force the distended vessels of the encephalon can exert against the skull.

S E C T. CCLXXII.

TH E parts are retained in their situation by excluding any external pressure by a bandage and dressings.

The other part of the curative indication described in §. 270, was to retain the raised parts of the depressed bone in their natural situation, and this may be very easily done, barely by preventing any external pressure

pressure from acting upon or injuring the affected parts. For the whole mass of the encephalon, naturally filling the skull, being freed from the compressure of the indented bone, will rise up and sustain the replaced bone, so that it cannot by its weight fall down again. Whence it does not seem necessary to use any great force nor instruments to retain the replaced bone in its situation. Hildanus (*a*) gives us the figure of an instrument, for preventing the replaced bone from subsiding. It consists of a screw fixed into the skull, there being several perforations in the handle of the screw, through which an iron probe or wire may be passed to any length, so that by placing compresses under each end of the probe, the screw and replaced bone will be held up; but it must apparently be very troublesome, to leave a screw fixed in the skull for so long a time, and from what was said before, it is evident there is no necessity for it. It is sufficient to form a ring of paper, lint, or some other substance, a little larger than the affected part, and to so secure it there by a proper bandage, that it may remain immoveable, and invest the whole compass of the affected parts. Thus the bandage applied to the head may be prevented from pressing upon the affected parts; nor can the parts then receive any injury or compressure from the patient's laying his head on the pillow, or any other obstacle.

S E C T. CCLXXIII.

IF arteries, veins, or lymphatic vessels, are so ruptured by a fissure, fracture, or contusion of the skull, that they extravasate their contained juices within the cranium, these extravasated juices pressing on the brain, may produce all the maladies of 267; and by corrupting into matter or ichor, they may infect the other

(*a*) Observat. Chirurg. Centur. 8. observ. 4. pag. 82.

other very tender parts of the brain adjacent, and this way again produce all the like symptoms. These vessels running from the skull into the dura mater, from thence into the pia mater, and from thence into the substance, sinuses, and ventricles of the brain, produce various symptoms, according to the different parts, which are more or less dangerous and difficult to remove.

If the wounding cause acts so violently on the head, as to be able to split, break, or contuse the hard bones of the skull, it is evident there must be great danger of a rupture in the blood-vessels or lymphatics, which are dispersed through the membranes, and even thro' the substance of the brain; and the extravasated juices from these ruptured vessels being confined under the skull, will compress the encephalon which it contains. For, as we have several times observed before, the whole cavity of the skull is always most exactly filled; so that extravasated humours cannot be there collected, without pressing upon the contained encephalon; whence all those maladies are to be feared, which may arise from this compression, and which we enumerated in §. 267. For it matters not in this case what the compressing cause be, whether an alteration in the figure of the skull, so as to lessen its cavity, or an extravasation of the humours, the capacity of the skull remaining the same, so that the humours take up the space which the brain itself before occupied, and with which the skull was before most exactly filled; for the effect will be always the same, namely, a disturbance or abolition of the functions of the brain, from a compression of its substance.

The blood-vessels distributed through the dura mater are sufficiently strong, as being furnished with the same tough coats that invest them in almost all other parts of the body, whereby they are more difficultly
broke.

broken. But if it be considered, that the dura mater every where adheres most firmly to the skull, it will easily appear, that the violence of the wounding cause may be readily communicated from the skull to the dura mater, by the continuity of their substance: add to this, that in a fissure or fracture of the skull, the dura mater is in the highest danger of being lacerated, or in some degree wounded by the sharp splinters of the bone. But the blood-vessels dispersed through the pia mater are very large and numerous, which also enter the substance of the brain, and are composed of exceeding thin coats, (because they deposite their hard and thick coats before they arrive at the brain, as is evident from anatomy) whence they will be liable to be ruptured, notwithstanding they are better secured from injury.

Besides this, the humours extravasated from ruptured vessels naturally degenerate and corrupt by their stagnation; and thus becoming acrimonious, they may inflame, suppurate, erode, and destroy the tender pulp of the encephalon; whence again all the like maladies will arise, as was before observed to proceed from compression; but the case will now be much more dangerous, because there might be a possibility of recovering the lost functions of the brain, by removing the compressure; but when the structure of the organ itself is destroyed by an erosion of its tender vessels, the disorder is then incurable. And that such like symptoms will follow from extravasated and corrupted humours, is evident from what has been said in the comment on §. 170. numb. 1. B. and §. 268.

From hence it appears, that large wounds of the head, in which there is a fracture of the skull sufficient to discharge the extravasated humours, are often less dangerous than small wounds of the head, where the extravasated humours are confined under the skull. See the commentaries on §. 265.

That a rupture of the sanguiferous arteries and veins will extravasate their contained blood, every body will allow;

allow; and that all the bad symptoms before enumerated have arose from the compressure of the brain, by this extravasated blood, is evident from incontestible observations. But whether the lymphatic vessels ruptured by the same cause, are capable of discharging so much lymph as to produce the same compressure of the encephalon, is much to be doubted; since those vessels are so small, that it very rarely happens that a rupture of the lymphatics is occasioned without a rupture also of the blood-vessels, in the meninges of the encephalon. But that there are such vessels of the encephalon as convey a thin lymph, is very sufficiently evident: for the whole surface of the dura mater, next the pia mater, always appears moist; and so does likewise the whole external surface of the encephalon: the whole extent of the ventricles in the brain is moistened with such a thin humour, without which the contiguous surfaces of those parts would grow together in a little time. Now if this thin juice, which is continually discharged through the very fine vessels in form of a vapour, be not absorbed again by the veins, it may be accumulated, and will then produce all the diseases of the brain: and accordingly we are furnished with innumerable observations in authors, of such a lymphatic liquor being collected betwixt the dura mater and the brain, and betwixt the pia mater and its tunica arachnoides, as also in the ventricles of the brain itself, &c. The whole superficies of the ventricles in the brain, has been also observed to be covered with a very fine membrane, which appears to be vascular, from injections and inflammations thereof (a). But these small vasculæ do not naturally contain red blood, but a thin lymph. And besides, the common lymphatic veins, as they are called by anatomists, have been found in this part, and are figured by Ridley (b). Since therefore an incredible quantity of lymph is sometimes discharged from wounds in other parts of the

(a) Winslow Exposition Anatomique, &c. pag. 623.

(b) Ridley Anat. Cereb. F. 5. l. 44.

the body, therefore the encephalon seems to be liable to the same accident; and this we are assured by the frequent observations of Physicians. A lad seven years old received a blow on his head with a stick, and after head-achs, watchings, drowfiness or sleepiness, a vertigo, &c. he died on the twenty-sixth day: the anterior ventricles of the brain were found distended with a very limpid serum (c). A certain illustrious prince falling down from on high, hit the left side of his head so violently against the steps, that he lay almost half dead for near a whole day without sense, motion, or speech, but after bleeding he a little recovered himself; yet there followed a most violent pain of the head, which raged intolerably both night and day, so that he could get no sleep. It was at length agreed on by the common consent of the most skilful Physicians, to apply the trepan; but almost as soon as the instrument was going to be used, a serous liquor began to distil from the left ear, and this flux continued 'till eight pounds were discharged (d). There are many more of the like observations to be found; but in all the cases such a lymph has been found in the brain, a considerable time after the wound was inflicted, or else it has discharged itself from the ears, &c. so that there only remains some small room to doubt, whether this accumulation of lymph was caused by a rupture of the lymphatics, or by some other mean?

These vessels running from the skull into the dura mater, &c.] Now according as the humours extravasated from the ruptured vessels, are lodged in different parts of the encephalon, by their compression or erosion they may injure different functions. Thus, for instance, when humours extravasated in the ventricles of the brain, have reached the fourth ventricle, which is the beginning of the rima or division that runs all down the whole length of the spinal medulla, then they may even penetrate into the spinal medulla, and

(c) Bohnius de renunciât. vulner. pag. 182.

(d) Miscell. curios. decur. 1. an. 6. observ. 12. pag. 22

and produce various particular palsies and an hemiplegia, &c. But under similar circumstances the disorder will always be the worse, and more difficult to cure, as the extravasated humours are lodged deeper in the encephalon. For blood extravasated betwixt the skull and dura mater, will immediately discharge itself upon trepanning or perforating the cranium; or if lodged betwixt the dura and pia mater, then it cannot be discharged without perforating the former. If again the extravasated humours are lodged in the ventricles, or about the basis of the brain, the case is evidently the most dangerous and difficult to cure, being frequently altogether impossible, since no exit can be procured by art, to discharge the extravasated humours from compressing the encephalon.

S E C T. CCLXXIV.

A Violent shock, or concussion of the head will also frequently produce the same effects (273), by lacerating or compressing the soft parts of the encephalon, even though the skull remains entire.

It sometimes happens, that by falling from a high place, or by a blow with an obtuse instrument, the brain is so much injured, though the skull remains entire, that all the symptoms follow which we before enumerated. For when a person falls from a high place, and hits his body against a hard obstacle, then the brain descends with the same velocity; but then the resisting obstacle first stops the motion of the skull, and the mass of the brain at that instant continuing the same direction of its motion, will be forcibly stuck against the hard skull, and by that means be considerably injured; in the same manner as when a person standing in a boat that is swimming, if an obstacle suddenly stops the motion of the boat, he nevertheless

continues to move forwards, and tumbles down. It is indeed true, that the mass of the encephalon very exactly filling the cavity of the skull, very much diminisheth the violence of the shock; yet it may be sufficient to break the tender vessels of the encephalon, which extravasating their contained juices, may excite all the consequent symptoms, as we are taught by medical observations. *Pulchra virgo, Nerei filia, annorum viginti, ab amica muliercula ludente lata manu synciput percussa est, ac tunc tenebricosa vertigine prehensa est, nec respirabat; cumque domum pervenisset, illam statim febris prehendit, & caput doluit, & rubor erat circa faciem. Septima die ad aurem dextram pus prodiit graveolens, subrubrum, cyatho amplius; & videbatur melius se habere, & levata est, &c. nona die periit (a):*

“ A handsome virgin of twenty years old, daughter
 “ of Nereus, was struck in play on the forehead with
 “ the open hand of another young woman, her
 “ friend, and she was thereupon taken with a scotoma
 “ or dark vertigo, and lost her breathing; and when
 “ she was got home a fever immediately seized her,
 “ with a pain in the head, and a redness about her
 “ face. On the seventh day a foetid matter came
 “ from her right ear, of a reddish colour, to the quan-
 “ tity of a small cup-full; hence she seemed to grow
 “ better, and was easier, &c. but on the ninth day
 “ she expired.” It is evident enough, that so slight a blow with the open hand could neither make a fracture, fissure, nor the least depression in the skull; but the brain itself was so injured, that the humours extravasated from its ruptured vessels, corrupted and degenerated into a foetid and reddish ichor, and at last even destroyed the patient. There are a great many similar instances given us by the more modern writers of observations, from whence it is evident, that the encephalon may be so affected by a violent concussion of the head, without injuring the skull, as to rupture its larger vessels, and by extravasating their contained blood

(a) Hippoc. Epid. lib. 2. textu 32. Charter. Tom. IX. pag. 344.

blood under the skull, kill the patient. It may be sufficient for our purpose to add one such instance. Bohnius (*b*) inspecting the body of a girl sixteen years old, who died on the fourth day after a fall, in order for him to report the cause of her death to the judges: yet he could not observe any effects of violence in the head, though she bled plentifully at the nose and mouth after the fall, while living, and even some time after she was dead; but upon opening the skull, and raising the brain, he found the foremost branch of the right carotid was broke. This instance teaches us, how large an artery may be ruptured by bare concussion, without injuring the skull, though the artery was secured under the basis of the brain; and therefore it is evident, the like injury may happen to the other vessels of the encephalon. But since it is evident from physiology, that the arteries dispersed thro' the pia mater are immediately spent in a fine vascular down, as soon as they enter the substance of the cortex, and that those tomentous vascules are continuous with the smallest medullary fibrils; it is easy to conceive, that so violent a concussion might rupture or compress those very fine vascules and fibrils of the encephalon, upon which our life and human faculties depend: and from hence might follow an injury of various, or an abolition of all the functions of the encephalon, even though no extravasation of humours or injury in the skull could be discovered; for these parts we now speak of are so minute as to escape the eye. A strong young man, to avoid being broke upon the wheel, clapt his hands behind his back, and threw himself head foremost against the wall of the prison with so much violence, that instantly he fell down dead without once speaking or crying. Upon examining the body, neither tumour, contusion, nor fracture, was to be perceived in the vertex of the head, which struck against the wall, as they testified, who were confined in the same prison. After re-

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moving all the integuments, no injury appeared in that side of them next the skull; nor in the skull itself, except that the squamose part of the os temporale was a little departed from the parietal bone, over which it extended, but that could not occasion so sudden death. After the top of the skull was sawed off, no other damage appeared, than that the encephalon did not so exactly fill the capacity of the cranium as it usually does; and the whole substance of the encephalon appeared more compact and firm than usual (c). From this history it is evident, that the sudden death following this violent percussion of the head, could be only ascribed to the subsiding of the whole brain, whereby its very tender fibres were either broke, or so twisted and complicated, that they remained no longer pervious to the subtle spirits, which ought to be conveyed by them to all parts of the body.

We may also conclude from what has been said, that different functions of the encephalon may be injured, according to the different parts of the organ affected by the concussion. Hippocrates says, (d) *Quibus cerebrum quadam occasione concussum fuerit, illos quam primum voce privari necesse est*; “ that they who
 “ have by any accident suffered a concussion of the
 “ brain, must necessarily be very soon deprived of
 “ their voice:” And in another place he adds, that such, (e) *nec videre nec audire necesse est*, “ must consequently be incapable both of hearing and seeing.” And Heurnius (f), in his commentaries to this aphorism, says, that he has known some, who by a fall on the occiput, have lost their taste and smelling all their life-time afterwards. A lad of four years old who could talk freely, fell down upon his head from a pair of stairs, at that time no damage appeared: but when the child arose out of bed the third day
 after,

(c) Acad. des Sciences, l'an. 1705. Histoire, pag. 68, 69.

(d) Aphor. 58. Sect. 7. Charter. Tom. IX. pag. 325.

(e) Hippoc. de Morbis Lib. I. cap. 2. Charter. Tom. VII. pag. 533.

(f) Pag. 504.

after, he began to flutter, and the disorder of his speech increased on the following days without any other injury; but by applying cephalic fomentations to the head, and exhibiting proper medicines internally, he recovered his speech entirely (*g*). But in another man there remained an extreme difficulty of speech for several years, after he had suffered a violent concussion of the head, particularly when he laid down (*h*). But such a concussion of the brain may arise not only from a violent percussion of the head, but also from falling or jumping from on high, so as to shock the other parts of the body. Such an instance we have in Galen (*i*), of a man who falling from a high place, struck the upper part of his back against the ground; on the third day afterwards his voice became very weak, and on the fourth day he was quite mute; his lower limbs were also paralytic, but his arms were not at all affected, &c. on the seventh day his voice and the motion of his legs returned. It is true, indeed, that Galen in this place only charges the spinal medulla with being injured; but since the lower limbs only were paralytic, it was not the beginning of the spinal medulla that was injured, for then the arms would have been also paralytic; so that the loss of speech in this case seems rather owing to the concussion of the brain.

S E C T. CCLXXV.

THESE injuries (273, 274) are discovered from the known cause, and its violence; from the parts affected, and bilious vomitings; from a depravation, diminution, or a total loss of the sight, hearing, smelling, tasting, or feeling; from a vertigo, dimness, and stumbling; from a

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(*g*) Miscell. curios. dec. 1. ann. 2. observ. 120. pag. 198.

(*h*) Acad. des Sciences l'an. 1732. Hist pag. 42.

(*i*) De Locis affectis, Lib. I, cap. 6. Charter. Tom. VII. pag. 395.

deep sleep, and a difficult or noisy respiration; or from a palsy, convulsions, delirium, lethargy, apoplexy, or shiverings, attended with a fever; a flux of blood from the nose, mouth, or ears, with a redness of the face and eyes.

This aphorism describes the signs by which we may know the encephalon to be injured by the pressure of humours extravasated under the skull, or by their corroding acrimony which they have acquired by stagnation; or, lastly, which indicate that the fabric of this tender organ is so disturbed or changed, that the functions thereon depending are either perverted or abolished.

From the known cause, its violence, and the parts affected.] If all these are known, they will afford much light towards the knowledge of the latent injuries. For if the wounding instrument was obtuse, and violently forced against the skull, there must always be great room to suspect a fracture or fissure of the skull. And again, the injury will be more or less dangerous, according to the different parts where it is inflicted; for in some places the skull is exceeding thin, and in others it is much thicker. In some places considerable arteries of the dura mater are lodged in deep sulci of the skull, so that if the wounding cause affects those parts, it may easily break or wound those vessels, and their extravasated blood will compress the encephalon.

Bilious vomits.] For these following wounds of the head almost constantly denote that the brain is injured; whether its action be disturbed either by the compressure of extravasated humours, or by the violent concussion only. But of this vomiting we spoke in §. 267.

From a depravation, diminution, or total loss of the sight, hearing, smelling, tasting, and feeling.] It is evident from physiology, that a sound state of the

the brain is required for the perception of those ideas which result from the impressions of objects communicated by the senses to the mind, and also that a free commerce is required betwixt the brain and the nerves, subservient to those senses. From hence it evidently follows, that if one or all these actions are either diminished, depraved, or totally abolished after wounds of the head; the brain is then so affected, that the origin of the nerves, subservient to those senses, is so compressed or otherwise injured, as to become no longer capable of transmitting the subtle spirits of the brain necessary to the due performance of those senses.

Vertigo, dimness and stumbling.] It was said before in the commentary on §. 267, that a vertigo or apparent rotation of the adjacent objects, is the slightest of all disorders of the brain; but that when the disorder increases, then a darkness attends: and the disorder is then called a scotoma or vertigo with darkness; and at the same time all the strength of the body is in a manner lost, the limbs tremble and flag, and at last the patient tumbles down. This denotes that not only that part of the common sensorium is affected, which gives rise to all the nerves of the senses, but that the disorder has also extended to that part of the brain where the nerves arise, which are subservient to the motions of the muscles. And hence it is, as we observed in the comment on §. 240. numb. 4. that Hippocrates enumerating the signs of malignity in wounds of the head, joins these three symptoms together, viz. a darkness, vertigo, and tumbling down. And in another place (a) he admonishes, to ask in all considerable wounds of the head, whether the patient tumbled down, and fell into a deep sleep or stupidity; for if any thing of this kind happened, the greater care will be required in the cure. He then adds as a reason, that this question is necessary, not for that it always denotes the brain to be wounded, but because

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the

(a) Proorrheticor. Lib. II. cap. 10. Charter. Tom. VIII. pag. 818.

the encephalon is then in some degree sensible of, or injured by the wound (τὸ ἐνκεφάλῳ ἐσακχ'σάντ' τὸ τῶματ').

From a deep sleep and stertor, or noisy and difficult respiration.] In the places we before cited, a deep sleep is always reckoned among the bad signs; and if a stertor accompanies it, it is then worst of all; that is, when they force out the air with the whole action of the breast, so as to make a noise, as it happens in an apoplexy; for then it denotes that the wound has abolished all the actions of the brain, and that the functions of the cerebellum only remain unaffected, or rather for the most part increased, since the free circulation being impeded through the brain, the humours will be forced so much the more strongly and swiftly through the cerebellum.

Palsy or convulsions.] Since the motions of the muscles depend on the sound state of the brain, so far as they are influenced by or subservient to the will; therefore an injury of the brain may render some or all of the muscles in the body paralytic; and because the muscles in that state are loose and flaccid, or inactive, therefore the disorder is termed a resolution or paralysis. But when the muscles under the influence of the mind are violently and alternately contracted against the will, the patient is then said to be convulsed; and these generally follow when the spirits are freely transmitted through some parts of the brain, and impeded in others. This accident may also arise from bony splinters, pricking the medullary substance of the brain; or from the corrosion of extravasated humours, rendered acrid by stagnation, &c. But either of these symptoms always denote that the brain itself is injured in wounds of the head.

Delirium.] That is, when the ideas formed in the mind are not agreeable to the external objects, but arise from some change within the common sensorium, then a man is said to be delirious: whence it is evident, that a delirium is always a bad sign in wounds of the head, because it denotes that the brain itself is injured:

injured. Which is also an observation made by Hippocrates, as we observed before in the comment on §. 267.

Lethargy.] This disorder is said to be present, when the patient is possessed with a sort of idle forgetfulness, accompanied with a loss of sense and motion, and an unavoidable propensity to sleep; but so however, that the sleeping patient may be awakened by every thing which strongly affects the senses; but then they soon fall to sleep again. So that this malady denotes all the functions of the brain to be very much impeded, and is therefore constantly of dangerous import.

Apoplexy.] All the symptoms which we have hitherto enumerated, denote indeed that the brain is injured, but that only some of its functions are depraved or abolished; whereas if all the actions of the brain are silent, and all the senses both external and internal cease, with the voluntary motions, the action of the cerebellum only remaining, which is subservient to the vital motions, then the patient is said to be in an apoplexy; which is one of the most desperate diseases of the brain, and generally denotes in wounds of the head that the brain is compressed by extravasated humours.

Shiverings.] Which almost constantly denote in this case, that the blood is extravasated from the ruptured vessels, especially when they return without any certain order, and do not accompany an incipient fever: for we frequently see in diseases, that great changes are preceded by such shudderings; and therefore this symptom is always to be suspected in wounds of the head, since it in a manner denotes a disturbance in the common sensory, from whence those concussions of the whole body follow.

Accompanied with a fever.] It was said before in §. 158. numb. 6. that a slight fever always attends at the time of suppuration in wounds of any consequence; which fever is therefore of no bad presage; but

but when this fever is suddenly increased, or when a more violent fever arises after this is over, it constantly denotes a latent evil. And therefore, says Hippocrates, (b) *Quibus cerebrum vulneratur, febris plerumque ac bilis vomitus accedit, & corporis sideratio, atque tales perniciose habent*: “ That those who have the
 “ brain wounded, are generally invaded with a fever
 “ and vomiting of bile, an apoplexy, and the like
 “ pernicious symptoms.” And in the place before cited from him in §. 240. numb. 4. he says, it is well if the patient wounded in the head has no fever, &c. but if any of these happen, it is safest for them to appear in the beginning, &c. but for a fever to arise, after a wound in the head, on the fourth, seventh, or eleventh day is very fatal. For such a fever denotes a new inflammation or violent suppuration, so extremely dangerous in this part. Hence the case we before cited from the second book of Hippocrates’s Epidemics, which we mentioned under the preceding aphorism, to be attended with such a fever, was followed with the very worst symptoms, and terminated in death itself. For that girl but slightly struck with the open hand upon the forehead, immediately fell into a fever; when on the seventh day a reddish coloured foetid matter was discharged to the great relief of the symptoms, the fever again increased, she became sleepy, lost her speech, the right side of her face was contracted, her respiration difficult, with tremors, convulsions, &c. so that she expired on the ninth day. If we examine the histories of wounds in the head given us by the writers of observations, we shall meet with many instances of the like kind, which teach, that a fever arising so suddenly anew, or increasing several days after the wound, have been of bad import; and that then the encephalon has been constantly either compressed or injured.

A flux of blood from the nose, mouth or ears.]
 It does not seem possible for the blood extravasated
 under

under the skull to be by these ways discharged, since the dura mater so very accurately invests all the internal surface of the skull, that there is not the least passage. But yet it appears true from practical observations, that a flux of blood and humours by these ways has frequently relieved chronical disorders of the head; which Hippocrates (c) remarks, when he says: *Capite laboranti & circumquaque dolenti, pus aut aqua, aut sanguis effluens per nares, vel aures, vel os, solvit morbum*: “That a flux of blood, matter, or
 “ water, from the ears, nose, or mouth, in those who
 “ have disorders and universal pains in the head, terminates the disease.” But anatomy has not hitherto discovered by what ways these humours can be thus discharged from the cavity of the skull; but they might possibly be made by the disease, though they did not naturally pre-exist. Thus there are also instances of the like humours being discharged by unknown ways in other diseases: for thus a pleurisy is terminated by a spitting, through the vessels of the lungs, &c. But certainly, if there was such an easy passage for the discharge of blood extravasated under the skull, there would be no need of trepanning the cranium; which yet appears both useful and necessary from such a vast many instances. But blood flowing from the mouth, nose, or ears, denotes that the wounding cause has very violently affected or shocked the head, since it has been able to break the arteries by its force, and therefore there is great danger, lest it should have also ruptured the blood-vessels of the encephalon, which have first deposited their strong coats, before they run upon the surface of the brain.

Redness of the face and eyes.] The blood sent from the heart by the carotid arteries, is drove partly to the internal parts of the head by the internal carotids, and partly to the exterior parts of the head and to the face, by the external carotids. When therefore extravasated blood compresses the brain, the free course
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(c) Aphor. 10. Sect. 6. Chapter Tom IV pag. 253.

of the humours through the brain is then impeded, and therefore it will be carried with so much a greater force through the external carotids, whence the face will appear more red, tense, and florid. And because the internal carotid, after arising out of the bony channel through which it is transmitted to the brain, sends branches to the orbit of the eye, and to the eye itself, and there communicates with branches from the external carotid; therefore the free course of the blood through the brain being impeded, the eyes especially look red, because a greater quantity of blood is thus derived to them by the branches they receive from the internal carotids. And hence it is that a redness of the face and eyes affords such a suspicious sign in all disorders of the head. Those who lie possessed by a strong apoplexy, appear with a red and inflated, or turgid face. This florid countenance is therefore so highly condemned by Hippocrates; and the girl had also a redness in the face, whose history we related in the preceding paragraph from Hippocrates, and a slight blow upon the forehead being the cause of her death. This redness of the eyes, and florid colour of the face, is in many places condemned by Hippocrates. Thus he says, (d) *Qui caput dolent, cum stupore delirantes, alvo suppressa, feroci oculorum aspectu, floridi, opisthotonici fiunt*: “That those who having a pain in
 “the head, are also stupidly delirious, have a consti-
 “pation of the bowels, are flushed and look fierce in
 “the eyes, these will be convulsed backward.” In which place we are to understand by the fierce aspect of the eyes, their becoming turgid and suffused with blood, as we see in a violent fit of anger. He likewise adds, (e) *Quæ caput concutiant, oculi prærubri & manifeste delirantia, perniciofa*: “That the eyes appearing very red and manifestly delirious in those
 “who have had a blow on the head, is a bad symptom.”

(d) Coac. Prænot. No. 163. Charter. Tom. VIII. pag. 861.

(e) Ibid. No. 163.

S E C T. CCLXXVI.

BUT what parts within the skull are injured, is known, 1. from the external signs, (249, 254, 255, 256, 262, 267, 269) if there are any; 2. by detecting the part of the skull injured by art (255); 3. from the tumour and redness of the skin, first cleared of its hair to apply the plaster; 4. from a spontaneous motion of the patient's hand, while he is senseless, to a certain part of the head; 5. from the symptoms of one side being paralytic, and the other convulsed.

After it is evident by the preceding signs that the encephalon is injured by the wound, whether it be by a penetration of the wounding instrument within the skull, or by a depression of its bones, or a compression from the extravasated humours; the enquiry must be, in what part of the encephalon the injury resides. It is very evidently a matter of the highest moment to know this; since the skull cannot be rightly trepanned before the injured part is discovered, where the malady resides; and yet it is often a very difficult matter to discover the place affected. For sometimes the injury has been found in a part very remote from that where the wound was inflicted, as observed in the commentary on §. 254. And also frequently neither the patient nor the by-standers can tell which part of the head received the blow. Nor can this be determined with certainty, from the injury of the functions to be observed after the wound: we may indeed from thence conclude, that the brain is injured, but no body will dare to say, that he can always be thence certain what part of the encephalon is injured. Who will presume to determine, what part of the brain gives rise to each individual nerve subservient to the external senses;

ses; or who will demonstrate the seat of memory, reasoning, &c. in this surprising and intricate, or inscrutable organ? Celebrated men have indeed feigned strange hypotheses to solve these difficulties, but the event has taught us, that the highest wits may egregiously err, by indulging themselves with mere speculations or fancies. The great STENO, who was so well skilled in anatomy and its enchirsis, ingenuously and publicly confesses with the rest of the learned, that he was quite ignorant of the fabric of the brain (a): and in his excellent dissertation on that subject, he has demolished the trifling figments advanced by many, and pointed out to us the true way by which only human industry can arrive at a knowledge of the fabric of this organ. But in the mean time, we ought as much as possible to enquire, by the signs mentioned in this aphorism, after the part of the encephalon injured: and if any error should arise, after an accurate examination of all these, it will be no fault in the artist, but a defect in the art, which may perhaps be improved by the discoveries of future ages.

1. Of these we treated under the aphorisms here cited.

2. In the aphorism here quoted, all the signs by which injuries are discovered in the skull, are ranked in their proper order: if therefore it appears from thence that the skull is in any part injured, and at the same time also the symptoms appear, demonstrating that the encephalon is likewise injured; this will afford a very probable reason to think, that the encephalon is affected in the same part where the skull is injured.

3. When it appears from the signs enumerated in §. 275, that the encephalon is injured, and yet no sign makes it evident which is the part affected; in that case surgeons endeavour to detect or determine the part affected in the following manner. They first shave off all the hair with a razor, and then apply an
aromatic

(a) Winslow Exposition Anatomique, &c. pag. 641.

aromatic emplaster to the whole head, and suffer it to lie on for some hours: and then upon removing the plaster, they very diligently inspect whether any part appears tumefied or inflamed; and if so, then there is good ground to suppose that the parts are affected under this place. For while the aromatic emplaster firmly adheres to the skin of the head, and by its gentle stimulus a little augments the motion of the blood and humours through the vessels, if any part has been contused it will manifest itself in a tumour. But when art cannot discover in what part of the head the injury resides, this unhappy case is then pronounced by Hippocrates incapable of being relieved by any means (*b*).

4. How this comes to pass scarce any one will pretend to say; but that the thing is so in fact appears from daily and certain experience. Even on the day in which I now write this, I saw a man who by a fall had hit the right side of his head and face against a hard obstacle, which occasioned a violent contusion and slight wound in these parts; this man continually lifted up and touched the affected parts with his right hand, and even rubbed them sometimes pretty strongly; but after the man had come to himself by plentiful bleeding two hours after the accident, he said he did not know or remember that he did this. Surgeons therefore observing that the hand of the wounded patient is thus carried by an automatic or spontaneous motion to the affected parts, do thence probably conjecture the parts affected to be this way pointed out when there are no external signs of injury, especially when the patient's hand is continually directed by this spontaneous motion to one and the same part. The same phænomenon is also frequently observed in apoplexies. And certainly it will appear that this sign ought not to be disregarded, if we consider that there are many such automatic motions which do not in any manner depend on the will, nor are they influenced or predetermined

(*b*) De vulner. capit. cap. 10. Charter. Tom. XII. pag. 119.

predetermined by the consciousness of the mind; which by the actions of the body endeavours to remove what it finds offensive or injurious to itself by this wonderful property given it by the Creator.

5. That corporeal organ which is the spring of sense and voluntary motion in us, seems to be double both in its origin, collection, distribution, and operation. For the carotid artery is both right and left, and the vertebral artery is both right and left: and from these arise the right and left hemisphere of the brain, which are very distinct from each other, and the whole collection of the medullary substance is also distinguished into right and left; and this evidently appears not only in the corpus callosum, fornix, crura of the medulla oblongata, the optic and olfactory nerves, &c. but also appears evidently in the medulla spinalis itself, and the nerves thence arising. But notwithstanding all these parts are thus formed double, yet the man who perceives is simply but one: the two olfactory nerves, so very distinct from each other both in their origin and progress, do yet afford but one sense of smelling. And though we really see the object twice, once with each eye, (as appears from the intermediate space betwixt the two eyes, or by only gently pressing the bulb of either eye with one's finger) yet vision is but single: and the same is also true of the hearing.

Since therefore this organ of sense and motion is double, therefore one part or side may remain entire, while the opposite is no longer affected by any corporeal object; as evidently appears in an hemiplegia, in which disease one half of the body is so relaxed or paralytic, that no motion remains in it capable of being performed by the influence of the mind; and yet that conscious faculty remains, which perceives and wills the motion; and though the person thus affected endeavours with all his might to move the paralytic side, yet no motion at all follows in the muscles; nay

farther,

farther, in the worst species of the same disorder, the whole side affected is likewise destitute of all sense.

All this has been long ago hinted by Hippocrates, where he says (c) *Cerebrum hominis duplex est, uti etiam in omnibus aliis animalibus; medium autem ipsius dividit membrana tenuis: quare non semper eadem capitis parte dolet, sed particulatim alterutra, aliquando vero per totum*: "That the brain of man is double, as it also
 " is in all other animals; for it is divided in the mid-
 " dle by a thin membrane: from whence it is, that a
 " pain of the head is not always in the same place,
 " but particularly on one side or the other, but seldom
 " throughout the whole." But then here arises a subtle question, whether this principle of sense and motion is placed on the opposite side to where it produces its effects, or whether it is placed on the same side of the body; that is, whether the spring of the senses and motions which are performed in the left side of the body, is placed on the right side or on the left side of the brain. This ought therefore to be determined by the most subtle observations and experiments of anatomists: and when once this is known, it will afford much light in wounds of the head, in order to determine which side of the encephalon is affected from the injury or loss of the sense and motion in the opposite side.

The very soft and pulp-like fabric of the brain has always occasioned much difficulty in the anatomical demonstration of this important viscus; but its consistence is the weakest of all in the younger subjects: for in old people, and especially in those who have been accustomed to hard labour, it is pretty firm, and may be more advantageously dissected. In the brain of such bodies, after a dissolution of the greater part of the cortical or cineritious substance of the encephalon, by a long continued maceration, the medullary fibres arising from the right hemisphere of the brain, appear evidently to cross over to the left side, and

those of the left hemisphere tend to the right. But this decussation of the fibres appears most conspicuous in three places; viz. in the notch betwixt the anterior and posterior annular protuberance, and still more evidently in the bottom of the peduncles of the medulla which pass into the medulla of the spine: but above all, this mechanism is most apparent about two lines below the corpora pyramidalia and olivaria, for if the corpora pyramidalia are gently drawn from each other, you will perceive not only a decussation of small fibrils, but very large fasciculi of them will evidently appear crossing to the opposite side (d). And this is almost all that anatomy has yet discovered, concerning the course of the medullary fibrils of the brain.

Now we are furnished with many practical observations, which confirm this cross-like action of the brain. A servant girl, twelve years old, had her skull fractured and contused; and the operation by the trepan being not performed as it ought, she died on the fourteenth day: (e) *Convulsio autem manum sinistram occupabat, in dextra tamen parte potius vulnus habebat*: In this girl, “the left arm was convulsed, whereas
“the wound was rather in the right side of the
“head:” And again, (f) *Quibus tempora secantur, ex adversa sectionis parte convulsio contingit*: “Those who
“are wounded in the temples have a convulsion fol-
“low in the opposite side.” And the same is also confirmed by Hippocrates in his admirable book on wounds of the head (g), admonishing, that an incision ought not rashly to be made in the temples, because such a wound would be followed with a convulsion; and also says, *At si sinistra tempora secta fuerint, dextra convulsioprehendit; si vero ad dextra fuerint secta tempora, sinistra convulsioprehendit*: “That if the left
“temple was incised, he found the right side convul-

“fed;

(d) Santorin. Observat. Anatom. cap. 3. pag. 61, 62.

(e) Hippoc. Lib. V. epidem. textu 23. Charter. Tom. IX. p. 341.

(f) In Coacis Prænot. numb. 498.

(g) Cap. 19. Charter. Tom. XII. pag. 123.

“ fed; but that when the right temple was wounded, “ the left was convulsed.” And in the same book, where he treats of the signs denoting whether the patient will die of his wounds in the head, he says, (h) *Plerosque etiam altera corporis parte convulsio occupat. Si quidem sinistra capitis parte ulcus habuerit, dextram corporis partem convulsio prehendit. Si vero dextra capitis parte ulcus habuerit, sinistram corporis partem convulsio prehendit*: “ That those thus wounded are generally “ convulsed in the opposite side of the body: if the “ wound was in the left side of the head, the right “ side of the body was convulsed; but when the “ wound was in the right side of the head, a convul- “ sion took the left side of the body.” And thus were observations made in the most early times of physic, confirming this opinion.

Among modern authors, Fabricius Hildanus, who for the most part barely relates what he saw without any mixed reasonings, gives us several observations confirming this doctrine. A man of forty years old was struck on the left parietal bone with an iron ball of above a pound and a half in weight, which caused a considerable fracture and depression of the skull. He fell to the ground as one dead, being totally deprived both of his sight, hearing, and speech, and was taken with a palsy in the opposite side; but by elevating the depressed skull, and other proper means, he was at length perfectly cured (i). A man of sixty years of age had a considerable depression of the os frontis, on the left side, at the margin of the hair of the scalp, by a blow with a stone. The moment he received the blow he fell down to the ground, vomited and lost his speech, sight, hearing, and intellectual faculties, and was taken with a palsy throughout the whole opposite side. His friends would not suffer the depressed parts of his skull to be raised by in-

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cising

(h) Cap. 19. Charter. Tom. XII. pag. 123.

(i) Hildan. Observat. Chirurg. Centur. 2. Observ. Exempl. 1. pag. 78.

cising the integuments, and so he expired in a few days after (k).

A woman received a contused wound on the right parietal bone, with a considerable fracture and depression of the skull. She soon after the accident vomited up bile, with the food she had not yet digested in her stomach; the left side of the body was paralytic, and the right side was convulsed. But she afterwards recovered, even though she lost a considerable quantity of the substance of the brain through the wound (l). A strong young man received a wound by a stick, on the left parietal bone, accompanied with a fracture of the bone: by dilating the wound, and extracting the fragments of the bones, the wound was in five weeks time after almost cicatrised; but he then having to do with a common woman, he fell into a fever in a few hours afterwards, and the pain of his head likewise returned. The side opposite the wound was paralytic, but the arm of the wounded side was convulsed, and seized with the cramp, and on the fourth day afterwards he died (m). A lad injured his head by a fall from a high place; at first the injury was thought inconsiderable, but afterwards the skull itself appeared naked in the middle of the wound, and a small hole was observed in the sagittal suture, which discharged a considerable quantity of matter: this purulent matter was sometimes stopped for a few days, and in that interval the patient was convulsed strongly in his right arm four or five times in a day, for the space of a quarter of an hour at each time, and the right side of his jaw was likewise convulsed in the same manner; but so soon as the purulent discharge returned, these convulsions ceased. At length the lad died, and the whole left lobe of his brain was found suppurated, the

(k) Hildan. Observat. Chirurg. Centur. 2. Observ. 3. Exempl. 3.

(l) Ibid. Centur. 1. Observat. 13. Exempl. 1. pag. 21.

(m) Ibid. Observat. 19. pag. 25.

the right lobe and cerebellum remaining quite untouched (n).

Valsalva (o) testifies, that in a large number of dissections he always found, that when one side of the body was paralytic, the injury constantly lay on the opposite side of the brain, and he enumerates the learned witnesses who were present at these dissections. And if the injury sometimes penetrated to the other side of the brain, yet the damage was always the most considerable on the opposite side. Among the learned who were present at these experiments, he mentions *Petrus Molinellus Philos. & Med. Doct.* (p) whose remarkable experiment is as follows: he opened the left side of the skull in a living dog, and after making several punctures in the dura mater, he observed the dog had convulsions in several parts, especially when he punctured that part of the dura mater which strongly adhered to the skull, but that he was not at all taken with any apoplexy. At last he quite cut out the left lobe of the brain, and the dog instantly tumbled down, not on the left side as he expected, but on the right, and upon being lifted up, fell upon the same side again. At the same time the right side was also found to be destitute of all sensation, whereas the left side retained both its sense and motion. He then adds, that he had known several perform the like experiment with the same event; and from all this he concludes, that the celebrated Morgagni and Lancisi had justly pronounced, that one might easily conjecture which side of the brain was injured, by observing on which side the patient was paralytic.

Many observations of the like nature might be alleged both in diseases and wounds of the head, which confirm this opinion; but I suppose what has been al-

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ready

(n) Acad. des Sciences l'an. 1700. Hist. pag. 56, 57.

(o) De Aure humana, pag. 85, 86. cap. 5.

(p) In Commentariis de Bononiensi scientiarum & artium instituto, pag. 139.

ready said, will be sufficient. But this opinion is more especially confirmed by the experiment last mentioned to be tried on a dog. And yet we acknowledge there are some observations occurring in authors, which oppose this opinion; one or two of which objections we shall briefly relate.

A lad of eleven years old fell into a deep lethargy, and while he lay in the most profound sleep, the whole right side of his body was paralytic, or destitute of sense and motion. Forestus being called to this patient, and finding no other remedy at hand, applied some bruised thyme and vinegar to the right nostril, and by that means the lad was in some degree revived: and at the same time a thick, bloody, and much corrupted matter, like putrid fordes, was discharged from the nose. Hence Forestus predicted, that the right side of the brain was invaded with an abscess and sphacelus. In a little time the child died, and Forestus seeing the case desperate, was about to depart, a little before its decease; but the lady of quality who had the child in her care, during the absence of its parents, detained him to open the body, and discover the cause of his death, that it might be reported to his parents. After removing the skull, the brain and cerebellum on the right side, and towards their back part, were found bloody and putrid, or corrupted, but the left side of the brain was found white and sound, without any corruption. And thus his presage was verified in the dead subject, which procured him great fame (q). This case, which is so exactly described, directly opposes what was said before, and seems to be of considerable weight against us.

A young man was hurt on the left side of his head, on the parietal bone, and the day after he had convulsive motions in the right side of his body, and the whole left side was found paralytic. A contusion appeared to extend itself all over the region of the left bregma, and eight fragments had separated themselves

(q) Forest. observat. Lib. X. obs. 11. Tom. I. pag. 414.

selves from the bone, one of the sharpest of which was found depressed through both the meninges into the substance of the brain (r). In this case the palsy was of the injured side; which is quite contrary to the cases a little before related in favour of our doctrine.

Valsalva (s) candidly owns, that having no intention to impose on any one, he had in one or two cases observed and found the injury extending equally to both hemispheres of the brain, and yet he frequently saw that the palsy lay on the side opposite to that of the wound in the brain.

But it ought also to be considered, that frequently no injury is discoverable in the brain after death, and yet its functions have been observed egregiously injured before the patient's decease; since a very slight change or compression of its tender medullary fibrils will be sufficient to excite any, even the most malignant symptoms, as Valsalva teaches us in the place cited, by a very beautiful experiment.

The cardiac nerves of a dog being constricted in the throat by a strict ligature, and again instantly set at liberty, they were thereby so much injured in their invisible structure, that the dog died in a few days, as if they had been totally divided; and yet upon examining those nerves afterwards, no injury could be perceived in them. Hence therefore in those cases alledged, the opposite hemisphere of the brain might have been injured in its fabric barely by concussion, though no injury therein could be discovered to the senses after death. And this will appear still more probable, if it be considered, that even the hard skull itself is often fissured on the opposite side, while the part itself which received the blow remains entire, as we before observed in the comment on §. 254.

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(r) Bonet. Sepulcret. f. Anatom. Pract. Lib. I. Sect. 15. Observ. 7. pag. 373.

(s) Le Aure humana, cap. 5. pag. 86.

Since therefore innumerable observations of the most celebrated authors, and experiments made on living animals, confirm this cross-like manner of sense and motion in the brain; and as there are very few instances repugnant to this opinion, and those are thus capable of being explained, that they make little or no opposition; it is therefore evident, that if this opinion is not absolutely true, it is yet highly probable, that is, if one side of the body is paralytic, and the other convulsed, then the cause of the disorder within the skull lies on the side opposite to that which is paralytic. But when the right side of the body appears convulsed, and no injury at all can be observed on the left side, it will thence seem very probable that the left part of the brain is so affected, that its equable influx of spirits into the muscles of the right side is perverted or disturbed, though not totally cut off. Such has been the state of this part, in some of the instances before alledged.

But it ought to be well observed, that this opposition or decussation of direction, which is discovered by these experiments in the brain, does not take place in the nerves; for the nerves arising on the right side, are distributed into that side. It is true, there have been some celebrated anatomists of the contrary opinion, and who particularly believed that the optic nerves thus mutually decussated each other, thinking the optic nerve of the right eye arose from the left side, and of the left eye from the right side; and philosophers have thought that this mechanism would solve many of the difficulties or appearances in optics. But a chance accident has taught us the contrary; for the celebrated Santorini (*t*) dissected the body of a man whose right eye had been long before blind with a true amaurosis, without any visible defect in the eye. The optic nerve of this eye was found smaller than it ought to have been, and of a more obscure colour, namely, of an ash colour; which enabled this expert anatomist

(*t*). Observat. Anatom. cap. 3, §. 14. pag. 64.

anatomist to trace it very exactly; and he found that this nerve, so easily distinguishable by its colour, all along kept to the right side of the brain; and he also evidently saw at the same time, that the fibres of the optic nerves neither decussated, nor mixed among each other; but that they only met, and then divided again.

S E C T. CCLXXVII.

THEN, 1. the extravasated blood is to be immediately discharged or removed; 2. the parts affected are to be cleansed; and 3. the bony fragments which have happened to penetrate the brain are to be extracted.

When it is once evident, that the wounding cause has injured the functions of the encephalon, the first enquiry must be what injury the encephalon has sustained; whether an indentation of the skull compresses the brain; whether any sharp fragments prick and lacerate; whether any of the humours are extravasated under the cranium; or whether the injury arises from concussion. But by what signs these different causes are discovered, we have before declared in §. 171, 172. A violent concussion may so injure the tender pulp of the encephalon, as by compressing its smallest vessels, to prevent the free course of the humours through them: but if those vessels were not totally obstructed nor ruptured, an equable circulation of the humours may again open those collapsed canals, and after a few hours the functions will again return by degrees. But when any extravasated juices are lodged under the bones of the skull, so as to compress or injure the encephalon, the general curative indication directs to remove them, as is very evident: and then the Surgeon must attend to the three heads of this aphorism.

1. The reason of this is very evident: for any extravasated humour here lodged will compress the brain, since it naturally fills the skull itself: and if this compression continues long, the contiguous sides of the small canals may grow to each other, and remain impervious, as long as the patient lives; whence the injury of the functions of the brain will be afterwards incurable.

2. This is to be done when the extravasated humours are corrupted and changed into matter, ichor, or fordes, so as to infect the adjacent parts upon which they are lodged; as also when the solid parts are so vitiated; that they cannot be reduced again to their healthy state.

3. for observations teach us, that these splinters will sometimes happen; and therefore they are to be removed or extracted.

S E C T. CCLXXVIII.

THE extravasated blood is removed, 1. by resorption, 2. by dispersion, and 3. by perforating the skull.

1. In contusions, when the blood is extravasated from the ruptured vessels under the entire skin, and forms an ugly black or livid spot in the affected place, yet we frequently see that this extravasated blood will all of it disappear by degrees; for it is attenuated by the thinner juices brought thither, and afterwards absorbed by the bibulous veins. And therefore why may not the same likewise take place here? For extravasated blood may lay a long time without corrupting, in a place where there is no access of the external air granted.

2. That is, by so attenuating the extravasated blood with diluent and resolving medicines, that it may enter the bibulous veins, which open as well within the whole

whole internal as external superficies of the body; and being absorbed, it will be carried off, and gradually disappear.

3. Where the quantity of extravasated blood is so great as to cause a violent compression of the encephalon, and greatly injure its functions, there is then no time allowed to attempt this slow absorption or dispersion of the extravasated juices; for in that time the patient would be lost. There then remains but one, though a severe method of relief, namely to give a discharge to the extravasated blood, by perforating the skull.

We are now therefore to examine how each of these are to be performed.

S E C T. CCLXXIX.

IT will be absorbed when it is repelled by the *vis vitæ* into the veins, first evacuated by plentiful bleeding, or purging of the bowels, near akin to the former.

When the skull is opened in some live animal that is young (because in such the skull is more easily removed), a vapour will manifestly appear perspiring from every point, the whole surfaces of both the meninges are moist, and the whole compass of the ventricles is beset with a kind of dew. There is therefore a very thin liquor continually exhaled from these minute vessels, which waters or moistens all the internal parts. But if there were not also small absorbing veins in those places, this moisture would be constantly increasing and accumulated, 'till by compressing the encephalon it destroyed all its functions. The extravasated blood must therefore be absorbed by the mouths of these veins. It may perhaps seem surprising, that the blood which so soon congeals after it is let out of the vessels, should be capable of entering the

the mouths of these small vessels; but if it be considered, that the congealed blood taken from a vein does again gradually dissolve itself into a thin liquor; and that this is performed sooner when assisted by a moderate warmth, and besides also continually diluted with a most thin exhaling dew; and that as the skull is always full, it must be strongly pressed, and the arterial fabric of the encephalon, especially of the dura mater, being alternately dilated and contracted by the impulse of the blood from the heart, will evidently occasion the blood here extravasated to be every moment pressed, ground together, and diluted with a most thin liquor, so that being thus attenuated, it may at length enter the small mouths of the absorbing veins. But as these small absorbing veins convey their absorbed humours into the larger veins; therefore this absorption of the extravasated juices will be promoted by evacuating the larger veins; and for this purpose plentiful bleeding is recommended, and likewise such purges as plentifully evacuate, and powerfully dissolve the humours without any great stimulus, and discharge them when dissolved without any great commotion, attenuating those which remain, whereby the vessels will be less distended, and the course through all of them facilitated. Thus it evidently appears, that the absorbed humours will return into the evacuated veins, and that the body being rendered dry by these evacuations, will powerfully absorb any liquors that come into contact through its whole external and internal superficies. Thus intense thirst is observed to follow strong purging, and the liquors drank are as speedily absorbed, by the venal orifices opening into the cavity of the stomach and intestines. But how much this method will perform towards the absorption of the extravasated blood, is apparent to the eye in violent contusions. I saw a tumour of this kind equal to a child's head, formed on the nates by a fall in skating, which was entirely dispersed by this method; and this even though the
parts

parts looked black with the blood extravasated under the skin. Scarce any one will pretend to say, that the extravasated blood exhaled through the entire skin; for if it could be so attenuated as to pass through the exhaling vessels of the skin, it is very evident, it might as easily enter the mouths of the absorbing veins. It is therefore evident, that much good may be hoped for by this method.

S E C T. CCLXXX.

T Herefore both these evacuations (279) are to be made at one and the same time, as plentifully as the patient's strength will permit, and to be repeated again as often as necessary, if you find the symptoms (275) relieved after their administration.

It will never be injurious to make these large evacuations, if the patient is strong; and more especially repeated phlebotomy is here of very great service; for it has been frequently seen, when all the signs have denoted the brain to be compressed by blood extravasated under the skull, that even then a profuse or bold discharge by phlebotomy has lessened all the symptoms, though but a little before the use of the trepan was thought of. And if the disorder does not yield to these remedies, and it is afterwards found necessary to use the trepan, yet this method may be of service, by rendering the body less subject to inflammation; for thus the worst symptoms which sometimes follow trepanning of the skull, and especially the fungous excrescences of the brain, may be much prevented. It therefore seems that these remedies ought first to be tried before the use of the trepan itself. But if now the symptoms following a compression of the brain from extravasated juices, begin to diminish by these evacuations, we know then that there is great hope that

that a repetition of them will compleat the cure, provided a regard be always had to the patient's strength. It affords me some pleasure to reflect on the happy success which I have oftentimes had by this method: and Parey (*a*) gives us a remarkable instance of his bold and repeated use of phlebotomy. A young man, aged twenty-eight years, received a violent blow by a fall on the left parietal bone; there was a contusion, but no fracture of the skull. On the seventh day he was taken with a violent fever, delirium, and great inflammation and tumour of the whole head, face, and neck; his speech, sight, and deglutition were also interrupted: on the day following the Surgeon took away twelve ounces of blood: but Parey being called on the next day, and finding the malignant symptoms not abated, and the patient's strength considerable, he took two and forty ounces of blood more from a vein; and on the next day, finding the symptoms rather increased, he took again twelve ounces of blood, and after that bled the patient twice, to the quantity of fifteen ounces each time, so that within four days time the patient lost above eighty ounces of blood, and was entirely cured of those dangerous accidents. Hippocrates (*b*) has, indeed, cautioned us that *evacuationes ad extremum ductas periculosas esse*, "evacuations carried to a very great length are dangerous;" and therefore it might thence seem rash to take so large a quantity of blood: but then in the same section he again opposes to this another axiom; (*c*) *ad extremos morbos extrema remedia ad amissim optima*, "that in extreme diseases extreme remedies are accordingly the best." Since life is therefore in danger here, unless the patient be timely relieved, therefore the reason for these profuse evacuations is evident: for in the slightest cases no prudent person would presume to use them thus.

S E C T.

(*a*) Liv. X. chap. 14. pag. 231.

(*b*) Aphor. 3. Sect. 1. Charter. Tom. IX. pag. 7.

(*c*) Aphor. 6. Charter. Tom. IX. pag. 11.

S E C T. CCLXXXI.

THE disperſion of the attenuated blood is performed, 1. by the reſorption (279, 280) of the parts to be diffipated; 2. by attenuating with watery diluents, and reſolving drinks taken warm; 3. by applying diſcutient, nervine, and cephalic plaſters, cataplaſms, and fomentations to affected parts, after they have been ſhaved; 4. by applying the ſame remedies to the ears and noſe.

A diſperſion is, when the extravafated blood is ſo attenuated, either naturally or by art, that it may be capable of entering the minute orifices of the abſorbing veins, and by that means gradually diſappear.

1. Of this we have already treated.

2. If any one takes the congealed blood drawn from the vein of a healthy man, and waſhes it in warm water, the coagulum will gradually leſſen, and the warm water will be tinged red, 'till at laſt the maſs will be ſo much diminiſhed, that one would ſcarce believe it; yet ſome part will always remain, perhaps, becauſe the blood has been ſo long expoſed to the free air. For we daily ſee in contuſions, that the extravafated blood will diſſolve ſo as to diſappear entirely. For this reaſon it is, that after bleeding and purging, as much of ſome watry decoction is given to the patient as he can bear, to render the juices permeable; thus the whole maſs of blood, is diluted, and a ſufficient quantity of exhaling dew ſupplied to diſſolve and attenuate the extravafated blood and fit it to return through the minute abſorbing veins. But ſince mere watery liquors, drank plentifully after bleeding, and other evacuations, greatly weaken the body, ſo that they are retained in the habit after indigeſtion, and incline the body to a dropſy; therefore ſome mild ſpices ought to be added to thoſe decoctions,

tions, and which having a gentle attenuating power and stimulus, are esteemed for this use; and such will never be pernicious, after these evacuations have preceded. For the whole intention is to render the blood so dilute, that a large quantity of thin dew may pass by the exhaling arteries to the extravasated blood, and so attenuate and dilute the same, that it may re-enter the mouths of the small absorbing veins. The form of such a decoction you have in our professor's *Materia Medica* corresponding to this section.

3. It is indeed true, that all these cannot directly and immediately extend their efficacy to the extravasated humours lodged under the skull, since the external parts of the head receive their humours almost entirely from the external carotid. But they are yet of service, by so warming and relaxing the external parts of the head, as to diminish the impulse of the humours towards the internal parts; and at the same time some particles of those remedies returning into the common circulation, by the external veins of the skin, may be afterwards conveyed, by the common laws of the blood's motion, to the parts affected. Nor ought we to cavil about the manner in which remedies act, provided they are found of service in practice. Thus when acute inflammatory diseases invade the internal parts of the head, fomentations of water, vinegar, and nitre, are applied to the head, after being shaved, with very good success. Hence in these dangerous maladies all the forces of art should be assembled, which are capable of giving any relief, though but small. But then in the use of these we ought always to have a regard to the cautions which we gave in §. 245, 246, 247, and constantly observe to keep the cataplasms or fomentations in a due degree of warmth, which may be done by the frequent application of hot cloths. The form of such a plaster and fomentation may be seen in the *Materia Medica* of these aphorisms, corresponding to numb. 247.

4. It is indeed certain; that the dura mater very exactly invests the internal surface of the skull, so that the whole encephalon seems to be included by it from any external communication; but yet it is evident from medical observations, that these two passages, the nose and ears, are a kind of drains to the brain, from whence sometimes very extraordinary humours are these ways discharged. It is said in the comment on §. 275, that chronical disorders of the head are often very speedily relieved, when a flux of water, matter, &c. is discharged from the nose and ears; and the same is also confirmed by the testimony of Hippocrates. It is well known how useful a bleeding at the nose is in all disorders from a plenitude or infraction of the vessels belonging to the encephalon, or from an inflammatory spissitude of the humours. There are some instances related in the comment on §. 273, from whence it appears, that after violent injuries of the head, the patient has recovered by a large flux of lymph from the ears, and that even in cases where the most expert Physicians and Surgeons advised to use the trepan. These therefore seem to be the nearest passages to the internal parts of the head. In reality the thin lamella of the os ethmoides is fixed at the top of the nose, perforated with many small foramina, through which the productions of the dura mater, and branches of the olfactory nerves are conveyed from the brain in the living subject, where they exactly fill those foramina; but then, how thin is this bony partition, which thus divides the cavity of the skull from the nose! so that vapours drawn through the nose, are almost immediately applied to the encephalon.

S E C T. CCLXXXII.

IF the symptoms (275) are not either immediately removed, or much diminished by these

means (279, 280, 281), but they either continue or increase; then the skull is to be immediately perforated to give a discharge to the humours (273, 277, 1°.), and to give an opportunity to cleanse the parts (277, 2°.) and to extract the fragments (277, 3°.).

It would seem both rash and cruel always to trepan the skull in these cases, where the signs denote that the functions of the encephalon are much injured after wounds of the head. For unless it appears evidently that the skull is depressed, or that some fragment of it injures the encephalon, in such a manner that no relief can be had without the trepan; unless the case be such, one ought, instead of immediately perforating the cranium, to wait a few hours, to see what effects plentiful evacuations will have in the mean time, which should be first tried for relieving the symptoms. For many of these cases occur daily, where men having tumbled down from high places, have lain deprived of all sense and motion, but in a few hours afterwards they have revived; so violent has been the disturbance of the brain from such a shock, though none of the humours were extravasated. And even where the application of the trepan is necessary, plentiful blood-letting, previously made, will never be prejudicial; but, on the contrary, highly serviceable. So that the method recited in the three preceding paragraphs, seems necessary to be always tried first; and if in the space of twelve hours, no benefit can be perceived from the use of these remedies, but all the symptoms rather increase, there then remains but one other method of relief, namely, by procuring a discharge to the extravasated humours, by perforating the skull with a trepan. In this case therefore the patient's friends are to be acquainted that certain death is at hand, but that there still remains this one doubtful and difficult operation, from
whence

whence much benefit may be justly expected; but a certain cure ought never to be promised: for it is possible that after the skull is trepanned, the humours may be extravasated in such parts, that they cannot any way escape. Also the tender fibrils of the medulla of the encephalon, on which depends our life and humanity, may be ruptured by the shock. But wherever this operation is absolutely necessary, the sooner it is performed the better: for the humours continuing to flow from the ruptured vessels, the compression of the encephalon will thence be increasing every moment, and thus frequently the tender fibrils of the medulla, pervious only to the thinnest juice in the whole body, being compressed laterally, and their sides brought into contact, cease to be any longer open canals, so that after the compressing or extravasated humours are removed, the contiguous sides of these smallest vessels cannot then be opened and removed from their contact, by the equable circulation of the juices; they therefore coalesce or grow together, and occasion an incurable injury of all the functions resulting from the course of the most subtle juices through those smallest canals. Besides this, the extravasated humours thus left to themselves for a considerable time may corrupt, become acrid, and corrode all the adjacent parts. From all which it is evident, that delays in these cases must ever be dangerous; though it must be also confessed, that the most faithful observations teach us, that trepanning of the skull has been very successfully performed a considerable time after the wound was inflicted. A man having received a wound in his head, without any very bad symptoms, it was healed up within the space of four days: but a considerable time after he was taken with a violent pain in his head, a vertigo, dimness of sight, and a palsy of the right arm, all which demonstrated there was some latent evil; hereupon Sculterus (a) laid bare the cranium in the twenty-ninth

(a) Armament. Chirurg. Observ. 13. pag. 211, 212.

week after the wound was inflicted, and by that means discovered a small fissure; he therefore perforated the skull in two places, and cut out the intermediate piece of bone with a trepan: so large an aperture readily discharged the humours confined under the skull, and in the space of a month's time the wounded patient was happily restored to his former state of health. But it is easily discernible from this account, that there was no quantity of extravasated juices under the skull in the beginning of the disorder; but that the matter was gradually collected thro' the fissure of the skull: for where any of the vessels are ruptured within the cranium, so as to extravasate their juices, it is then evident that the operation of the trepan cannot well be delayed without great danger. Hence Hippocrates says (b), in those cases where it is necessary to perforate the skull, *Intra tri-duum ad sectionem veniendum esse, neque ultra hoc tempus expectandum esse, præcipue si calida anni tempestate quis ab initio curam suscepit*: "That the perforation ought to be undertaken within three days, beyond which time one ought not to wait, especially if the cure has been undertaken from the first in a warm season of the year." But in this place he speaks of injuries in the skull, which are not capable of being taken out by the scalprum: for in cases where there is an extravasation of humours under the skull, it would be imminently dangerous to wait so long.

It is also usual to make a perforation of the skull, in order to elevate a loose or depressed bone, as we observed in the comment on §. 271: but in this case a threefold advantage may be expected from the operation, namely, to give a free exit to the extravasated juices; and when any thing is to be separated from the rest of the living parts by suppuration, to make a way for discharging the matter; and lastly, that the bony fragments or splinters which prick, lacerate, and injure the brain, may be conveniently extracted.

S E C T.

(b) De capit. vulner. cap. 22. Charter. Tom. XII. pag. 124.

S E C T. CCLXXXIII.

THE part of the skull where the trepan ought to be applied, is discovered, 1. from the known seat of the injury (276), which is the best place for the perforation, if nothing indicates the contrary.

After it has been determined to trepan the cranium, in order to give an exit to the extravasated humours, the next enquiry must be in what part it will be best to perform the operation. It is very evident, in cases where the place injured is discoverable by the fore-mentioned signs, §. 276, that there the trepan ought to be applied, because the extravasated blood is most likely to be lodged there. But the following aphorism will demonstrate, that there are many places in the skull where a perforation of it is either wholly impracticable, or at least highly dangerous; and therefore this rule must be restrained within those general bounds. But the part to be trepanned ought to be assigned not hastily, but after mature consideration, lest it should be found necessary to repeat this severe operation; which may be judged cruel in the eyes of the spectators, though the wounded patient being generally stupid in these cases, is insensible of the pain; and thus may a handle sometimes be given to those who defend the cause of the wounder, by imputing the bad consequences to the procedure of the Surgeons and Physicians.

S E C T. CCLXXXIV.

THE operation is forbid, 1. upon a suture; or, 2. where there are many muscles; 3. on the cavities of the os frontis; 4. on the entrance

entrance of a large artery into the bone; 5. the low situation of the place; 6. the looseness of the fractured, contused, or carious bone; and lastly, 7. on the inequalities or risings, and excavations of the skull.

1. When anatomists endeavour to raise the top of the skull, divided all round by the saw, they see plainly that the dura mater firmly adheres to every point of the skull; but then its adhesion is found so strict in the futures, that they can scarce force it up by the interposition of an iron wedge. It is therefore evident, that if the trepan was to be applied upon a future, the round piece cut off from the bone, could not be removed without greatly lacerating the dura mater, which might produce intense pains, convulsions, and other malignant consequences. Hence it is, that the futures are to be avoided by the consent of all authors, and the perforation of the bones rather made on each side the future, than in the future itself. In a man who received a violent wound upon the meeting of the coronal with the sagittal future, after the most grievous symptoms, many bony fragments were extracted, and the patient recovered, but Hildanus (*a*) could by no means prevent a fistulous ulcer from remaining in the place: and therefore he mentions difficulties of curing or healing up the wound, among those arguments he alledges against using the trepan upon the futures. But the celebrated Physician Johannes Fredericus Werdenbergius testifies, in an epistle to Hildanus upon the subject, that he saw an application of the trepan made upon the futures, while he was a student in Italy (*b*). But it is very apparent from what has been said, that it must always be dangerous to use the trepan on the futures.

2. It

(*a*) Observ. Chirurg. Centur. II. Observ. 8. pag. 85

(*b*) Ibid. pag. 86, 87.

2. It is well known that very strong muscles are incerted about the occiput, and in the lateral parts of the skull the temporal muscles are placed on each side; and therefore these places ought purposely to be avoided if possible. Hippocrates advises, (c) *Caput secanti reliqua quidem capitis tuto discindere licet, tempora autem, & quod adhuc supra est, juxta venam, quæ per tempora fertur, secari non debent convulsio enim sectum præhendit*: “ One who is about to open the head may “ perforate any part except the temples, and round “ about them, where the artery is distributed through “ the temples; these ought not to be incised, for if “ they are, the wounded patient, will be convulsed. And in the place alledged in the commentary on §. 241, he says, (d) *Quibus tempora secantur, illis ex adversa sectionis parte convulsio contingit*: “ That those who are “ wounded in the temples are convulsed in the oppo- “ site side.” From whence we may conclude it dangerous to injure these muscles; though the consequences following are not always fatal; for many observations demonstrate, that the temporal muscles have been removed for the application of the trepan, on the part where they are seated, and yet the patients have been cured. I shall mention one or two instances from a large number of these observations. A man was wounded with a scymitar on the left temple, with so large a fissure of the skull, that it would easily admit the fore-finger: and yet the patient recovered in a short time of so dangerous a wound (e). Riverius mentions the following case, in the observations communicated to him by M. Sam. Formie, Surgeon at Montpellier, where he had practised for above fifty years (f). A woman received a wound from a stone in her left temple: but when the trepan was found necessary to be applied by this expert Surgeon called in-

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to

(c) De capit. vulner. cap. 19. Charter. Tom. XII. pag. 123.

(d) Coac. Prænot. numb. 498.

(e) Sculteti Armamentar. Chirurg. Observ. 3. pag. 195, 196.

(f) Riverii Opera, pag. 572. observ. 19.

to consultation, he made no scruple of dividing the temporal muscle by a crucial incision, and of applying the trepan to the naked bone, nor did any bad symptom follow thence, as he assures us. A like instance was also communicated to the same Physician by another celebrated Surgeon, which he gives us in another place (g). In a lad twelve years old, who fell out of a high tree, the temporal bone was so fractured and shattered, that the Surgeon was obliged to remove a considerable part of the muscle, in order to discover the concealed injury, and apply the trepan: yet did the cure happily succeed; except only that the lower jaw remained a little distorted towards the opposite side (h). When the case is therefore urgent and necessary, it will be best to apply the trepan, even in these places, rather than leave the wounded patient to certain death.

3. Anatomy informs us, that the two places of the os frontis receding from each other, form a cavity termed the frontal sinus, which is usually pretty capacious, but of different extent in different persons, reaching from above the orbits of the eyes, almost to the middle of the eye-brows, and sometimes divided by bony partitions into less cavities, opening with two considerable apertures into each nostril, and by that means much increasing the internal capacity of the nose. This sinus is invested on all sides by the same membrane which lines the other parts of the internal nose. If then the trepan is applied to this part, after it has perforated the external table, it will meet the membrane lining the internal surface of the sinus, which must therefore be removed, with the membrane that covers the internal table, both which must be taken away, before the trepan can work upon the internal table of the cranium. It is very evident, all this must be extremely difficult, if not absolutely impracticable, since this membrane investing the internal

(g) Riverii Opera, pag. 580. observ. 19.

(h) Garangeot Operat. de Chirurg. Tom. III. observ. 15. pag. 131.

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nal cavities of the nose, is so extremely sensible, that by barely touching it with a feather a sneezing follows, and the whole body is convulsed. It must be also observed at the same time, that a wound here is hardly ever brought to cicatrise, if it has penetrated the frontal sinus. And this is a remark of Celsus (i), that all parts of the head, after trepanning, may be easily cicatrised, *Excepta illa frontis parte, quæ paululum super id est, quod inter supercilia est. Ibi enim vix fieri potest, ut non per omnem ætatem sit exulceratio, quæ linteolo, medicamentum habente, contegenda erit:* "Except that part of the forehead which is a little above the part betwixt the eye-brows. For in this place it will be scarce possible to prevent an ulcer from remaining as long as the patient lives, which must therefore be covered with lint armed with some medicine." This is also confirmed by the modern observations since made: and therefore this sinus, whose disposition is known from anatomy, ought to be avoided in applying the trepan.

4. If it be considered, that in the human skull cleansed, there are many impressions of large arteries made on its internal surface, corresponding to the ramifications of the considerable arteries distributed thro' the dura mater; it will be evident, that if one of those large arteries is wounded or lacerated, by turning round the teeth of the trepan in the bone, a very profuse hæmorrhage may follow, which may much disturb the operation, and frequently prove very difficult to suppress. But it can be no easy matter to determine these places, because the situation of these large arteries of the dura mater is various in different persons; yet are there some places in the skull where the impressions of these arteries are observed larger than in other parts, and which ought therefore to be avoided. Thus, for example, we observe such a large sulcus of an artery in the lower and lateral part of the parietal bone near the coronal suture, which grows gradually

(i) Lib. VIII. cap. 4. in fine, pag. 521.

gradually less as it ascends, &c. But these places are chiefly known by comparing different skulls with each other.

5. For if the extravasated humours are lodged towards the basis of the cranium, there can scarce be any hopes of discharging them, by trepanning the skull, since the operation can be only performed in a part much higher. But it is true, that as the cranium is always exquisitely full, the extravasated humours may be sometimes forced to ascend towards the trepanned aperture, by the pressure of the super-incumbent brain, and be by that means discharged; though even this must be apparently attended with much difficulty. Such a case is given us by Tulpius(k), in a drunken old man of seventy, who falling down from a high place, received so large a wound in his skull, that the extravasated humours, &c. which lay upon the dura mater, were easily discharged; yet he had a vertigo, vomiting, and stupidity: the day after he indeed returned to himself without a fever, or any other bad symptoms; but on the fourth day, after a purulent spitting, he expired suddenly apoplectic beyond all expectation. Upon opening the body a humour was found filling the ventricles of the brain, and a large fragment of the os cuneiforme appeared separated from the rest of the bone near the fella equina, with a good deal of concreted blood. Since therefore this extravasated blood lodged near the basis of the brain could not discharge itself by the opening of so large a wound; it is evident that but little can be expected from trepanning the skull in such a case. Hence Celsus justly pronounces, (l) *Servari non potest, cui basis cerebri percussa est*: “That a patient wounded in the basis of the brain cannot be recovered.”

6. While the trepan is applied to the skull, the
round

(k) Observ. Medic. Lib. I. cap. 3. pag. 6.

(l) A. Corn. Cels. Medic. V. cap. 26. Numb. 2. pag. 283.

round piece of the bone cannot be cut out by the instrument without exerting some pressure; if therefore in this case the bone is loose, and only adheres by a small portion, it will be depressed inwards, and greatly injure the subjacent encephalon. The like unlucky accident is to be feared, when the firm texture of the bone is decayed in the venereal disease; or when the skull is become carious from any other cause; for then even the least force applied to the trepan, will make it directly penetrate through the whole thickness of the bone at once. And that the bones of the skull may be thus corrupted after wounds of the head, is apparent from the instances mentioned in the commentaries on §. 242. and 256. numb. 3.

7. If the cavity of the skull be carefully examined, it will evidently appear unequal or rough in many places, in order to adapt itself to the encephalon with its vessels and sinuses; the bones of the skull are of various thicknesses in various parts. It will therefore be very serviceable to consider and compare different skulls, when the place is about to be determined for applying the trepan; and to observe where those inequalities are most commonly observed, to avoid them as much as possible.

But though it is evident from the rules of anatomy, that the parts of the skull enumerated in the seven preceding paragraphs ought to be avoided; yet in cases of the most urgent necessity, the operation may be attempted there, notwithstanding the inconveniences before mentioned: for it is better to try a doubtful remedy, than none at all, in cases where certain death is foreseen. It is hardly to be imagined, that all these cautions were observed, when a girl of twelve years old, after a fall from a high place, was trepanned in twelve different places of the skull within a few days time; which girl was however cured, though the whole parietal and part of the temporal bone was crushed to pieces by the violence of the fall.

This

This wonderful case is related by Dionis (*m*), whose son performed the operation four times on this girl.

S E C T. CCLXXXV.

THE next best place for applying the trepan, is the nearest to the known parts injured (276).

When the skull cannot be perforated by the trepan directly in the part injured, for some of the reasons before-mentioned, then that place will be best for the operation, which being free from those objections, is at the same time nearest to the part injured. But here it will be necessary to make some remarks of considerable moment. The dura mater adheres indeed to every point of the skull, but most strongly to the sutures, as was said in numb. 1. of the preceding paragraphs: hence the blood extravasated betwixt the skull and the dura mater may separate the latter from the former in any place but under the sutures, where their cohesion is too firm. If, for example, the injury is in that part of the parietal bone, which ought not to be perforated on the account of its nearness to the coronal suture, and to the large artery of the dura mater, which is there placed; in this case, the very nearest place to the part injured is to be chose, provided it be in the parietal bone: for if the trepan is applied to the os frontis, on the other side of the coronal suture, the blood lodged betwixt the dura mater and parietal bone cannot be discharged, because of the partition, or strict adhesion of the dura mater to the coronal suture, secluding the passage. Hence we see that this general rule, directing the choice of the part nearest to that injured, is to be understood with this restriction, when the trepan cannot be applied to the injured part itself. For thus the blood extravasated betwixt the
skull

skull and the dura mater may be confined, as if it were in distinct chambers or cells, which have no communication one with the other. The largest of all these spaces are those under the parietal bones, which are divided in two at the middle, under the sagittal future. This is also true in the forehead, which has a distinct space of this kind; and since the os frontis is generally divided in children by a future extended through its middle to the root of the nose, which is also frequently observed in the skulls of many adults, it is thence evident, that this space is thus partitioned into two.

But when the extravasated blood is lodged betwixt the dura and pia mater, it must be observed again, that the whole internal cavity of the skull is divided into two chambers by the falciform process of the dura mater, which is extended from the crista of the os ethmoides all along under the sagittal future, to the transverse process of the dura mater, which covers the cerebellum, and defends it from the pressure of the super-incumbent brain; this falciform process being deeply extended betwixt the two hemispheres of the brain, divides the capacity of the cranium into two chambers, and prevents the blood extravasated on the right side from passing to the left. And therefore in accidents of this nature, the mechanism now described ought to be particularly regarded.

S E C T. CCLXXXVI.

BUT when the symptoms (273, 275) are urgent, though no injured part of the skull (276) can be found, even then the trepan ought to be applied first to one part of the cranium, and then to another, for the ends mentioned in 277.

Sometimes it happens that all the symptoms denote the encephalon to be compressed by blood extravasated under

under the skull; and yet at the same time there are no certain marks whereby one can determine the particular part of the skull where the blood lies; in this case then the wounded patient must either be left to certain death, or the skull must be trepanned in several parts at a venture, without being previously assured of the event. For it is possible the extravasated blood may be seated in the basis of the skull, or be lodged in the ventricles of the brain itself, or at least it may be accumulated in some part distant from that where the trepan is applied. In such a case it seems most adviseable, after acquainting the patient's friends with the doubtfulness of success, rather to make trial of an uncertain remedy, than none at all; more especially, since it appears from innumerable observations, that a skilful application of the trepan is not any ways dangerous, and that the wounded patient is generally destitute of all sense: thus Dionis (*a*) tells us of a young nobleman, from whom he discharged the blood extravasated under the skull by the application of the trepan, and yet the wounded patient knew nothing of his having undergone such an operation, 'till he was told of it after the cure was compleated. So that though it may seem cruel in the eyes of the spectators to have fruitlessly applied the trepan in one part of the skull, and then to repeat it in another; yet it usually gives little uneasiness to the patient. But when it is wholly uncertain where the injury lies, it is then usual to trepan the parietal bone; because it makes one of the largest constituent parts of the skull, and has considerable large blood-vessels placed beneath it. If nothing is found by the first operation, it is to be repeated again on the parietal bone of the other side. We cannot find in Hippocrates, that he applied the trepan several times to the skull in the same patient: but from what I can collect out of his beautiful treatise of wounds in the head, his intention of perforating the skull was not to discharge extravasated humours

(*a*) Operat. de Chirurg. pag. 350.

humours, but to remove the fragments or injured parts of the bone. He indeed observes, that matter may be formed in a diseased bone of the skull, which might be transfused to the brain beneath (b); but does not mention any thing of humours extravasated from ruptured vessels under the entire skull. Hence he seems to have used the trepan only when the bones of the skull itself were injured, and the place sufficiently known; and therefore it is he asserts, that if the skull be fractured in a different place from the seat of the wound, it is a disaster no ways remediable (c). But Celsus seems to have been acquainted with this extravasation; for he says, (d) *Raro, sed aliquando tamen, evenit, ut os quidem totum integrum maneat, intus vero ex ictu vena aliqua, in cerebri membrana rupta, aliquid sanguinis mittat,isque ibi concretus magnos dolores moveat, & oculos quibusdam obcæcet. Sed fere contra id dolor est, & eo loco cute incisa, pallidum os reperitur, ideoque id quoque os excidendum est*: “That it sometimes, though seldom, happens that the whole skull remains entire, but internally some vessels in the membranes of the brain, ruptured by the violence of the blow, and discharging some blood which there concretes, produces intense pains, and sometimes a blindness of the eyes. But this pain is commonly on the other side, and when the skin is incised in this place, the bone looks pale, and therefore here also the skull is to be trepanned.” And in the same chapter he orders the skull to be perforated with several apertures when the fissure is long.

There are many instances in the modern writers on surgery, from whence it is evident, the skull may be trepanned in many places with success. A wound appeared in the parietal bone of a man who fell off from a horse, and by applying the trepan much blood was discharged, but without relieving the symptoms:
after

(b) Hippocrat. de capit. vulner. cap. 4. Charter. Tom. XII. p. 117.

(c) Ibid. cap. 12. pag. 119.

(d) A. Corn. Cels. Medic. Lib. VIII. cap. 4. pag. 516.

after three days time a tumour appeared in the occiput, which being opened, the trepan was again applied to the occiput, and much blood was discharged from the aperture, during the efflux of which the patient began to come to himself, and afterwards became perfectly well (e). This history well confirms what has been said in the preceding paragraphs; *viz.* that the blood extravasated betwixt the dura mater and the skull, is lodged as it were in distinct chambers, which have no communication one with the other. The same author in the same place mentions another case of a girl, in whom the trepan was applied to each of the parietal bones, and with very good success. In a large depression of the skull, Scultetus (f) was obliged to make seven apertures with the trepan round the margin of the depression, in one and the same day, in a certain captain, who was yet so well cured of so dangerous a wound, in the space of two months, that he could attend his military functions as before. And in that wonderful history which we mentioned in the comment on §. 284, the skull of a girl twelve years old was twelve times trepanned, with a compleat cure following. But the history given us by the celebrated Surgeon of his time, Solingen (g), is still much more surprising: Philip Nassau, a branch of the great Austrian family, hit his head such a blow, against a stump by a fall from his horse, that fractured his skull in several places; on which account the cranium was trepanned seven and twenty times by a Surgeon of Neomagen, and the patient perfectly recovered afterwards. Solingen saw a certificate signed by this noble person's own hand, attesting the truth of this account; and adds, that he had his constitution so firm after this, that he drank to death three of his bottle companions.

From

(e) Dionis. Operat. de Chirurg. pag. 340.

(f) Armamentar. Chirurg. Observ. 7. pag. 198.

(g) Manuale Operationen der Chirurgie, &c. eerste Deel, cap. 7. pag. 29.

From all this it is evident, that the application of the trepan, though frequently repeated, may be very safe when performed as it ought to be; as will be described in the following paragraphs.

S E C T. CCLXXXVII.

THE place being found (276, 283, 284, 285, 286), and the hair shaved off, the integuments are to be then incised (259), freed from the cranium, and then raised or turned back; next the bone is to be dried and covered with scraped lint, the blood stopped (218), the pain eased (227, 228, 229) and inflammation prevented (235); and if the disorder is not very urgent, the apparatus or dressings being rightly applied, are to be left on 'till the day following.

After the place is determined to which the trepan is to be applied, it will then be necessary to lay the skull quite bare of its integuments, lest the teeth of the trepan should lacerate the remaining soft parts: and more especially, great care should be taken that none of the pericranium be left adhering to the bones; for that being lacerated either by the scalprum or trepan, will excite a violent fever and inflammation, as Celsus tells us (a). Therefore the hair being shaved off, the integuments are to be incised down to the bone with a crucial incision, as mentioned in §. 259. The four angles of the incised lips are next to be elevated, and the pericranium freed from the skull either by the fingers or a scalprum; the blood is to be wiped off from the surface of the naked bone with soft pledgets of lint gently warmed; and some of the same lint is to be also interposed betwixt the raised integuments, that they may turn back more easily from the naked skull.

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(a) A. Corn. Cels. Medic. Lib. VIII. cap. 4. pag. 516.

The hæmorrhage here is usually slight and soon over; but if a branch of an artery a little larger than ordinary should be divided, it may be closed with some warm alcohol; or the flux of blood may be suppressed for some hours by a proper ligature or deligation of the parts by bandage; or if the symptoms urge, the divided artery may be immediately taken up with a needle and thread. For it is easily apparent, that the trepan cannot be applied so long as the hæmorrhage continues; for the blood continually running will obscure the whole, so that the operator cannot perceive how far the instrument has penetrated into the bone. If any pain invades the part, that may be eased by a superficial inunction with *Ung. Populnei*, which is very emollient, and at the same time anodyne; but generally the wounded patient is in these cases stupid or senseless of pain. If any inflammation be feared, and especially if the trepan is not to be immediately applied; but the operation is deferred to the day following, it will then be convenient to foment the parts with vinegar and water. Thus Hippocrates, in the passage cited in the comment on §. 259. numb. 3. finding it necessary to lay the skull bare, after the integuments were raised, he ordered the wound to be filled with lint, that by the swelling of the lint in the wound, it might be gradually opened or dilated for the more ample inspection of the parts injured: but then he advised the application of cataplasms of fine oatmeal and vinegar mixed and boiled together, to be continued during the stay of the lint, for preventing too much inflammation.

The question now arises, whether the skull being denuded, the operation ought to be put off for a few hours; or 'till the next day; or whether it ought to be immediately performed? In reality, the operation seems necessary to be performed with as much expedition as possible; because it is seldom used but in the most urgent cases. But there are usually two causes for which Surgeons are generally desirous to defer
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the operation: the first is, for that the shaving off the hair, and incising and raising of the integuments from the skull generally takes up so much time, that the patient's friends are unwilling he should be then any longer tortured: the second is, the advantage of having the hæmorrhage over, and the incised parts contracted and opened, so as to make more room for the application of the trepan. But if it be considered that patients thus wounded are generally destitute of sense, or at least very dull and stupid; and that the hæmorrhage may be very quickly suppressed, at least within a few hours, by the use of proper remedies; and that the divided lips may be sufficiently opened by incision, so as to make way for the trepan; it will therefore evidently appear the best of all to perform the operation immediately after the denudation of the skull.

Nor does the authority of Hippocrates oppose this advice; though he would have the examination of the injured bone deferred 'till the day after the integuments are incised (b): for, as we said in the preceding paragraph, he does not seem to have intended the operation of trepanning for a discharge of extravasated humours, but only for a removal of the injured part of the skull: and that indeed is a case that will more readily admit of being deferred without so much danger. But where the ruptured vessels continue to pour out their contained humours, if a discharge is not speedily procured for them, there will be great danger of such a compressure on the encephalon as will so much injure its functions, that they cannot afterwards be restored, even though the extravasated juices are discharged by perforating the skull. And even Hippocrates himself adds, in the same book (c), after he has enumerated the signs which denote the patient will be lost by the wounds in his head: *Si cognoveris febrem occupasse,*

K k 2

occupasse,

(b) Hippocrat. de vulner. capit. cap. 20 & 21. Charter. Tom. XII. pag. 124.

(c) Cap. 31, 32. Ibid. pag. 127, 128.

occupasse, vel aliud aliquid signum adesse, minime differendum est; sed os ad membranam usque serra secandum, aut scalpro eradendum est: “That if you shall perceive a fever invading, or some other malignant symptom attending, the operation ought not to be in the least deferred; but the skull is to be trepanned down to the dura mater, or else be scraped away with a scalprum.”

S E C T. CCLXXXVIII.

THEN the patient's head being held fast, his ears stopped, and the air of his chamber warmed; next the trepan with its spindle or pyramid, is to be applied to the bone first wiped dry, and gently worked round on all sides alike with an equable but small pressure from the superincumbent forehead, 'till the crown of the trepan has made a sufficient entrance in the bone.

To perform this operation with success, a regard must be had to the following particulars. The patient's head is to be so firmly secured, that he cannot any way move it; for which purpose he ought to be so placed upon the bed, that the Surgeon and assistants may have free access on all sides of him. The pillow for sustaining the patient's head has usually a piece of board, a pewter plate, or the like, placed under it, that it may not easily give way and disturb the operation. The Surgeon ought also to be certain of the strength and courage of his assistants, who are to hold the patient's head immoveable: for unless they are courageous, or used to calamities of this kind, they may faint, or leave their hold, especially as this operation may seem severe, and as it continues a long time. It is customary likewise to stop the patient's ears with cotton, that he may not hear the disagreeable grating of the saw or teeth of the trepan; but

Dionis observes (*d*), that this has been often neglected without detriment; and no wonder, since those generally lie destitute of sense to whom the trepan is applied.

All the necessary instruments being first disposed in order for the operation, and the circumambient air warmed and filled with the fumes of burnt amber, mastic, or the like, the part to which the trepan is to be applied, may be most conveniently illuminated by a wax candle. But the trepan used by the Ancients was a hollow cylinder; and of that shape the terebra used by Hippocrates, appears to have been (e). Celsus calls it *modiolus*, a round and hollow instrument of steel, with its bottom margin cut like a saw, with a nail or spindle in its middle, passing through the center of the hollow cylinder. But the *modiolus* seems to have been only used when the extent of the corrupted bone was small enough to be intercepted by its cylinder; for when the disease of the bone was of a considerable extent, they used the common terebra of carpenters, or an instrument much like it, with which they made a perforation: (f) *In ipso sine vitiosi ossis atque integri: deinde alterum non ita longe, tertiumque, donec totus is locus, qui excedendus est, his cavis cinctus sit, &c. Tum excisoriis scalper ab altero foramine ad alterum malleolo adactus id, quod inter utrumque medium est, excidit; ac si ambitus similis ei sit, qui in angustiorum orbem modiole imprimitur: “ In the margin or termina-
“ tion of the diseased with the sound bone; then they
“ made another perforation hard by the former, and
“ then a third, &c. ’till the whole piece to be cut
“ out was encompassed with these perforations, &c.
“ Then the intermediate pieces betwixt each perfora-
“ tion were cut out by a carving chissel, drove with a
“ little mallet from one hole to another: and thus
“ they carved out a circumference or ring in the bone,*
K k 3 “ resembling

(d) Cours d'Operations de chirurgie. pag. 355.

(e) Hippoc. de capit. vulner. cap. ultimo Charter. Tom. XI. p. 129.

(f) A. Cór. Cels. Medic. Lib. VIII. cap. 3. pag. 510, 511.

“ resembling that made by the smaller cylinder of the
“ modiolus.”

Now if the instruments used by the Ancients for trepanning the skull be compared with those in use at the present day, we shall readily perceive a very great difference betwixt them; because the defects perceived in practice have been since corrected. The old cylindrical trepan was a long time in use, even 'till the beginning of the last century; but in the use of this there was great danger, towards the end of the operation, of injuring the dura mater, by pressing the teeth of the instrument against it: and therefore it was since contrived to make the trepan of a conical figure, that its basis gradually enlarging, might be sustained by the sides of the perforated bone, so as to prevent it from slipping down and injuring the dura mater. But it is very apparent, that a conical-trepan could not descend through the bone as it is turned round, unless its sides were able to cut the margin of the bone to make way for its broader basis. The Moderns have therefore happily contrived a trepan, in the shape of a frustum of an inverted cone, with lateral teeth, or ridges all inclined the same way, and descending obliquely from their broader basis above, 'till they each terminate below the distinct points or teeth like those of a saw, of which teeth the lower rim of the trepan is composed: but the sharp lateral ridges, by paring away the sides of the bone, make way for the descent of the trepan; and the obliquity or inclination of them one to another, naturally raises and throws out the bony saw-dust, which would otherwise obstruct the free working-round of the trepan. The internal surface or hollow of the trepan ought to be well polished, and of a conical figure; for thus the round piece of bone cut by its teeth, will readily enter its cavity; and towards the end of the operation, the instrument may be inclined towards one side or the other, as may be found necessary; all which would be impracticable, if the trepan was cylindrical. The
figures

figures of the trepan and its parts represented by authors will afford a better idea of this instrument than can be had from a bare description. See Garengéot's treatise (g), where they are all represented.

A larger trepan is preferable to a less, when nothing contraindicates; for there is no manner of danger in making the openings large, which will afford a more free passage for the discharge of the extravasated humours. But to prevent the trepan from shifting or changing its place while it is applied to the skull, there is a small steel point or spindle fixed in the middle of it, so as to descend a little lower than the teeth of the crown, which sharp point prevents the teeth of the crown from shifting or straying out of their first track, 'till it is made sufficiently deep. This is termed a *male trepan*, which is furnished with such a pin in its center; but when that is removed, it is termed a *female trepan*. Formerly they used to keep two trepans of the same magnitude, one of which was furnished with such a pin in its center, and the other was without, because it could not continue working to the end of the operation with such a pin or spindle in its center; for the spindle being longer than the teeth of the crown, would enter through the skull first, and injure the dura mater. But at present they make this instrument so, that the spindle may be taken out of the crown, when the teeth of the last have made sufficient entrance into the bone. But it is always best to have two trepans ready of the same magnitude, lest some of the teeth of one should break and delay the operation.

Every thing being orderly disposed in readiness, a small hole or entrance is first made by the perforating trepan, as it is called, which is to receive the spindle of the male trepan; though this may be omitted, when the spindle of the male trepan is of a proper shape; for then it will with two or three turns easily

K k 4

make

(g) Nouveau Traité des Instrumens de Chirurg. Tom. II. pag. 98, 118, 134, 135.

make a way for itself. The trepan therefore furnished with its spindle, is now applied perpendicularly to the round piece of bone you would cut out, and then the thumb and fore-finger of the left hand are so applied to the versatile top of the trepan, as to form a hollow circle, upon which the Surgeon who performs the operation places his forehead, or as others would have it, his chin, that he may immediately perceive and correct the least error of the instrument's course: then taking the handle of the instrument in his right hand, he slowly and equably carries it round a few times, 'till the spindle gradually enters, and the teeth of the crown begin to work on the bone; and thus the circumvolution of the trepan, is continued 'till the circle is deep enough in the bone to guide the teeth of the crown, when the spindle is extracted.

S E C T. CCLXXXIX.

THEN the spindle or pyramid being taken out, the trepan continues to be slowly worked round, continually brushing away the saw-dust, 'till the appearance of blood, the softness of the bone, and the change of sound, denote the trepan to be arrived at the diploë; which diploë being frequently absent, those signs are often looked for in vain.

When the trepan has made a sufficient track in the outer table of the skull, the spindle is then taken out of the crown, lest it should injure the dura mater, by penetrating before the rest. This spindle seems also to have been removeable in the old trepans; for Celsus says, (*h*), in describing this operation: *At, ubi jam iter modico impressum est, medius clavus educitur, & ille*

ille per se agitur: “ But when the trepan has made
 “ its way, the middle point of it is extracted,
 “ and the instrument worked by itself.” But when
 the round piece of bone cut from the skull is to be
 afterwards extracted or raised by a screw, as we shall
 describe in §. 291, it will then be best to apply the
 screw before the trepan has reached the diploë; for if
 the screw be entered afterwards, it may be apt to di-
 vide the outer from the inner table of the skull, which
 would render the extraction more difficult: and there-
 fore the screw ought to be first applied to make its
 way in the bone, while the tables of the skull firmly
 cohere; which being done, it may be then extracted,
 and the trepan prudently worked round as before.
 For as Celsus observes (i), *Est enim, quidam premendi
 modus. ut & foretur & circumagatur: quia, si leviter
 imprimitur, parum proficit, si graviter, non movetur*:
 “ There is a certain method or degree of pressing the
 “ instrument, so as to make it enter the bone while it
 “ is turned round: for if it is pressed slightly it will
 “ cut but little, but if it be forcibly pressed against
 “ the bone it will stick fast.” The Ancients, who
 seem not to have used the trepan for discharging hu-
 mours extravasated under the skull, but chiefly for re-
 moving a corrupted part of the bone, continued to
 work the trepan ’till they believed it had penetrated
 to the sound part of the bone: and therefore, says
 Celsus, (k), *Cum sanitas inferioris partis scobe cognita est,
 modiolus removetur*: “ When the sound state of the
 “ lower part of the bone appears from the saw-dust,
 “ the trepan is to be removed.” For a diseased bone
 changes its colour; so that while the trepan works
 upon the diseased part of the bone, the saw-dust will
 be of the same colour, but when the trepan has entered
 so deep as to cut the sound part of the bone, it will be
 discoverable by the change of colour in the saw-dust.
 But since the trepan is seldom used at present for that
 purpose, but only to make an opening in the skull for
 discharging

(i) Liv. VIII. chap. 3. pag. 510.

(k) Ibid. pag. 511.

discharging extravasated humours, or for the more commodious elevation of the depressed parts, and the removal or extraction of the fractured pieces of the skull, &c. therefore the working of the trepan is continued 'till it reaches the diploë. But in doing this, the trepan is to be slowly and prudently worked round, and frequently taken out, that the saw-dust may be cleared from the ring cut in the bone, and from the teeth of the trepan itself; and then there will be no great danger of the instrument growing hot by the violence of the attrition. Tho' Hippocrates (l) was alarmed at this, and directs, *Terebram inter secandum sæpius auferendum esse, & in aquam frigidam demergendam, ne os incalescat. Terebra enim, dum circumducitur, incalescens, os calefaciens & exsiccans incendit, & facit, ut plus abscedat ab osse in sectionis ambitu, quam abscedere debebat*: “ To frequently remove the trepan during
 “ the operation, and to dip it in cold water, lest the
 “ bone should grow hot. For the trepan growing
 “ hot by turning it round, will heat, dry, and burn
 “ up the bone, so that a larger circumference of the
 “ bone will be removed in the operation, than was
 “ designed, or ought to be separated.” And Celsus (m) also directs to observe the same caution, in boring the skull with a terebra; but in applying the trepan he says, *Neque alienum est, instillare paululum rosæ vel lactis, quo magis lubrico circumagatur* (n): “ Nor is it
 “ amiss to drop in a little rose-water, or milk, to
 “ make the instrument work round more smoothly.”

But that the trepan has reached the diploë may be known from the alteration of sound, and the teeth no longer cutting in the hard substance of the bone, will afford a less resistance to be perceived by the hand: and as there are frequently very considerable blood-vessels distributed through the cellular substance of the diploë, therefore these vessels being ruptured
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(l) De capit. vulner. cap. 35. Charter. Tom. XII. pag. 129.

(m) Lib. VIII. cap. 3. pag. 512.

(n) Ibid. pag. 510.

or lacerated by the teeth of the trepan, will occasion the appearance of blood starting out, or at least to flow in a quantity sufficient to tincture the saw-dust of a red colour, which was before white. So far the trepan may be safely and boldly worked round, by the common consent of almost all Surgeons, who allow there is no danger before the trepan has penetrated the diploë: though even in the beginning a great many advise to be not over hasty, since it will be necessary towards the end, to work extremely slow, and with a suspended hand. But it appears from most certain observations, that the diploë is sometimes absent, especially in old age: and I have seen some skulls, in which the diploë was present in some places, and wholly absent in others; so that from hence a dangerous error might be committed. This seems to have been taken notice of by Celsus (o), when he advises: *Sed tum majori cura agendum est, cum jam aut simplex os dimidium perforatum est, aut in duplici superius. Illud spatium ipsum; hoc sanguis significat:* “ But the operation must be carried on with greater care, when the skull consisting of but one plate is half cut through, or when it consists of two plates, and the upper is cut through: the first may be judged of by the depth of the incisure, and the latter is denoted by the appearance of blood.” For though he seems in this chapter, as well as in the preceding, to treat of the disorders of bones in general; yet what immediately follows this passage, proves that he here speaks of perforating the skull: because he says, there will be danger of the point of the instrument injuring the membranes of the brain, &c.

(o) A. Corn. Cels. Medic. Lib. VIII cap. 3. pag. 512.

S E C T. CCXC.

THEN having washed out the blood, and stopped it with warm alcohol, after the saw-dust is well cleared away, then slowly, circumspectly, and patiently give the trepan only one or two turns more, constantly removing the saw-dust, and continually inspecting, to see whether the circle plowed in the bone changes colour or not; observing also whether you have penetrated equally on all sides, and then varying your pressure upon the trepan, according to the apparent variation of colour in the circle, the bone is to be thus so nearly cut through, as to let it adhere but by a very thin and equable plate or surface.

It is very apparent how much caution ought to be used, when the trepan has entered to the diploë; for then there only remains the thin, vitreous or interior table of the skull to be sawed through; and which is extremely thin in some skulls, and a great deal thicker in others. Also the arteries of the dura mater are lodged in deep sulci or grooves formed in the interior table of the cranium; so that if part of one of these should happen to be placed in the piece of bone cut out by the trepan, the instrument might penetrate and injure one of these considerable vessels, while in other parts the skull remained to be still divided to a considerable thickness. The unequal thickness of the skull in different parts, is likewise one reason for proceeding thus slowly and prudently in the operation. If a considerable hæmorrhage follows while the trepan cuts through the diploë, it ought to be restrained with heated alcohol; because this will otherwise impede the free inspection into the circle cut in the bone. The saw-dust is to be continually brushed out after
ever

every turn or two of the trepan; and attention must be given to the change of colour made in the saw-dust: for so long as the trepan works in the diploë, so long will the saw-dust appear tinged red; but when the teeth of the trepan begin to work on the inner table of the skull, then the saw-dust will appear white again. Frequent examination must be also made with a probe, whether the circle is cut of an equal depth in the bone, or whether the bone resists the contact of the probe in every point of the circle; or, if the bone being quite divided in some part, the soft membranes can be felt. At the same time it must be also enquired by inspection with a wax candle, whether the bottom of the circle appears equally white in every point, or whether the dura mater being perceptible through the thin lamella of the bone, occasions it in some place to change colour. For from all these a skilful Surgeon can tell in what part it will be convenient to work the trepan with a greater force, and where to press with a less force; and thus he gradually proceeds with the utmost caution, 'till only a very thin lamella of the bone remains to be divided; because it would be dangerous to cut quite through the bone, for fear of injuring the dura mater, which so closely adheres to the skull, and whereby violent inflammations would be risked, to the hazard of the patient's life, as Celsus (*a*) observes.

For this reason Hippocrates, who (as we before observed) used this operation not to make a way for discharging humours extravasated under the skull, but to remove diseased parts of the bone, would not have the instrument cut quite through to the membrane, lest that should be wounded by the trepan; but when the bone is so very nearly divided as to be loose, he orders the operator to desist, and suffer the bone to come away of its own accord; and thus he says there can no dangerous consequence follow a division of the bone, because there are some small parts still left

(*a*) Lib. VIII. cap. 3. pag 512.

left entire (b). But if the cure of the patient was not undertaken immediately after the appearance of the injury, but was taken out of the hand of another, the operation ought then to be made more slowly, and be continued 'till the bone is cut quite through to the dura mater: and he very fairly recounts all those cautions, which are even 'till this day observed by prudent Surgeons, to avoid injuring the dura mater by the teeth of the trepan. For he orders the track of the trepan to be often examined with a probe, and to work the trepan most on that part of the bone which appears thickest; and at the same time to make frequent trial whether the piece of bone cannot be loosened and extracted before it is quite cut through. All these Hippocrates advises to be observed by one who undertakes the cure from the beginning, and would cut through the bone quite to the dura mater (c).

The internal or conical cavity of the trepan has also an evident use; for the piece divided easily ascends into the cavity of the trepan, which grows gradually broader; so that the trepan may be easily inclined to one side or the other, when the inequality of the bone requires it towards the end of the operation, to make its teeth work most on the parts which appear thickest. Whereas, if the internal cavity of the trepan was cylindrical, it could not be inclined without pressing the sides of the piece of bone included in its cavity, which would obstruct the free circumrotation of the instrument, and frequently cause the upper table in the round piece of bone to separate from the diploë, whereby the remainder would be more difficult to extract. That this does sometimes happen is evident from Celsus (d); whether it be done designedly, when only the external table is required to be removed, because the injury of the bone penetrates no farther; or whether it proceeds from a fault in the instrument: for
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(b) Hippoc. de capit. vulner. cap. 34. Charter. Tom. XII. p. 128.

(c) Ibid. capit. ultimo, pag. 129.

(d) Lib. VIII, cap. 3. pag. 512, 513.

he says, *Ubi totum os ejectum est, circumradendæ levandæque sunt oræ, & si quid scobis membranæ insedit, colligendum. Ubi, superiore parte sublata, inferior relicta est, non oræ tantum, sed os quoque totum lævandum est, ut sine noxa postea cutis increseat; quæ aspero ossi innascens protinus non sanitatem, sed novos dolores movet:*

“ When the whole piece of bone is taken out, the
 “ margin that remains is to be rasped and smoothed
 “ all round, and if any saw-dust lies on the dura mater, it is to be gathered up. When the upper plate
 “ only of the bone is removed, and the lower remains, then not only the edges but the whole surface of the bone is to be smoothed, that a skin may afterwards grow over it without injury: and which
 “ being extended immediately over the rough surface of a bone, would not be found, but continually exciting fresh pains.” It is also apparent, that if haste is ever dangerous, it must certainly be so in this operation, especially towards the end; and that the best way of all is to leave a thin lamella of the bone remaining, because then the loose piece may be safely extracted; the method of performing which is taught in the following aphorism.

S E C T. CCXCI.

WHEN the colour of the bony circle appears bluish, and of an equal depth all round, with the shaking of the trepanned piece, denote that the skull is nearly perforated, the segment is then to be taken out, either by the lever, the screw, or the spoon.

When it appears from these signs that the trepan has entered so far that it cannot proceed without danger of injuring the dura mater; then the divided piece of bone is to be taken out. But this has been attempted various ways. Some have endeavoured to
 raise

raise the piece when free from the bone, by the interposition of a lever a little inflected; but in this way it is very evident, that while the piece is elevated on one side, it will be depressed on the other, and thus may the dura mater be injured by the rough margin of the piece broke from the bone; and even though the piece be prudently separated from the rest of the bone all round by such a lever, yet it will firmly adhere to the dura mater by the vessels mutually passing from one to the other; and it will be therefore very difficult to remove it this way. The best method of all seems to be, that by extracting it perpendicularly upwards, which may be performed by introducing a concave semicircular lever under each side the piece of the bone, holding it fast at the same time that the elevation is made on both sides at once; while the margin of the skull serves for the center of motion in these instruments. But if the adjacent parts of the skull are fractured, it is very evident, that even this method cannot be safely performed. This elevation or extraction of the piece may therefore be still better made, by fixing a spiral screw in the center of it, where the spindle of the male trepan has made its entrance (as we said before on the comment on §. 287.), gently turning the screw round, 'till it has taken firm hold of the piece of bone: thus it may be first carefully loosened on all sides, and then when it seems to have little or no more cohesion, it may be extracted perpendicularly upwards.

S E C T. CCXCII.

THEN the asperities on the sides of the perforated bone are to be smoothed by the lenticular knife, the saw-dust is to be taken out, and a passage procured for the blood and foul matter to discharge themselves by sneezing, holding the breath, and by pressing back the dura mater cautiously

tiously and seldom; and lastly, the aperture is to be filled and covered with thin and soft pledgets of lint, armed with medicines that agree with membranous and nervous parts, and adapting a plate of lead with ears over the whole.

Since the operation of trepanning, performed agreeable to the rules of art, always leaves the margin of the aperture rough and beset with bony splinters, formed by the evulsion of the round piece of bone, while it yet adheres by a thin lamella; and as the encephalon confined by the skull immediately protrudes itself into the opening, the dura mater would be injured by these splinters, if they were not to be removed by the lenticular scalpel (so called, because its point is obtuse like a pea); but what regards the figure and use of this instrument, may be seen in Garregeot (*a*). And then the saw-dust thus abraded, and lying upon the dura mater, is to be afterwards removed.

Sometimes it happens that blood, matter, or ichor, is immediately discharged from betwixt the skull and the dura mater, as soon as the trepan has made its way; and frequently none of these are discharged, though present. For the dura mater firmly adheres to the skull in every point, as we said before: and therefore if the extravasated humours are lodged betwixt the cranium and dura mater in a certain part of the skull, and the trepan is not immediately applied to that part; by the equal and strict adhesion of the dura mater on all sides, it will confine the humours so, that they cannot escape through the perforation, tho' made sufficiently near; and in that case a fresh perforation must be made in another part of the skull. But first a trial may be made, what can be done by the patient's holding his breath and sneezing; because

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(*a*) Nouveau Traité des instrumens de Chirurgie, Tom. II. pag. 21, &c.

thus the encephalon is distended with a larger quantity of blood (whose course being obstructed in the veins, while it is freely poured in by the arteries, as we explained in the comment on §. 271.), may urge the distending humours extravasated towards the trepanned aperture, where there is a less resistance. Sometimes also it has been observed, that though the confined humours have not immediately discharged themselves, yet they have come away of their own accord on the day following. But the more readily to promote the discharge of the extravasated juices, the Surgeon must carefully depress the dura mater, with the meningo-philax, an instrument furnished with an obtuse head or point like the lenticular knife, fastened to a round cylinder of polished steel, and thus denominated from preserving the meninges. This instrument being first a little warmed, to prevent the unaccustomed cold from injuring the parts, is then to be gently pressed upon the dura mater, which will cause it to recede a little from the margin of the aperture, and by that means facilitate the passage for the discharge of the extravasated humours lodged near the aperture: and by this means also the dura mater is at the same time prevented from being injured against the rough or sharp edge of the aperture in the bone, when the patient holds his breath. An instrument of the same name but a little different in its make, is described by Celsus (*b*): for his was a strong slip of brass a little inflected upwards; being used after the trepan to prevent the lenticular knife from injuring the dura mater, while it abraded the asperities of the bone. The same instrument was also used for raising a depression of the bone (*c*).

After the extravasated humours have been discharged it must be attentively considered, that the confining skull is deficient in the trepanned place; and as its cavity is always quite full, therefore the encephalon will begin to emerge through the aperture if

not

(*b*) Lib. VIII. cap. 3. pag. 512.

(*c*) Ibid. cap. 4. pag. 519.

not prevented, and especially if the dura mater is also wounded so as to form a fungous excrescence. And though the dura mater is left entire, yet if the aperture is not secured by a proper apparatus, it will be extended and thrust out of the perforation above the surface of the bone, as Celsus (*d*) observes. Therefore the deficient pressure of the skull is to be supplied by a suitable bandage. First a small round piece of soft linen is taken, a little bigger than the aperture cut in the bone, which being applied to the dura mater, is then thrust in a little way under the margin of the bone, all round betwixt the cranium and dura mater, and thus the rough margin of the bone is prevented from injuring the dura mater. To the middle of the piece of linen is fastened a thread for the more ready extraction of it. After this a few drops of Peruvian balsam may be instilled, or of some other vulnerary balsam of the like nature, and then the cavity is to be filled with round pledgets of lint of the same size with the aperture, first moistened with the same balsam: the opening being thus filled, pledgets of a little larger size are applied over it, and the wounded integuments dressed with some soft digestive; and then the whole apparatus secured by a proper bandage.

It is a happy and laudable contrivance of Belloste (*e*), to adapt a thin plate of lead of the same diameter with the trepanned opening; being furnished with two handles, and perforated with several small foramina, it is then dipped in some warmed vulnerary balsam and introduced into the opening. Over this leaden plate he applies some very soft lint to imbibe the extravasated juices; the two handles he bends back above the skull, and secures the whole apparatus with a proper bandage. By this means a fungous excrescence is prevented from rising up, through the opening of the dura mater; and the pledgets may be renewed without removing the leaden plate, which may yet be easily

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taken

(*d*) Lib. VIII. cap. 3. pag. 520.(*e*) Le-Chirurgien d'Hopital, pag. 69, &c.

taken out and replaced again, if there be occasion. This plate he used for fourteen days, and then removed it, lest its longer continuance should hinder the consolidation of the bone.

But because this leaden plate may be easily thrust upwards by the intumescence of the encephalon, if it is not confined by a proper bandage, especially as the aperture being made by a conical trepan, grows gradually wider; therefore another method has been also used by the Surgeons. They take one leaden plate of the same diameter with the lower aperture in the bone, and this having a thread fastened in its middle, is applied to the dura mater, and then across this they apply a thin slip of lead of about a line in breadth, and in length a little exceeding the diameter of the former plate; the two ends of this last slip are then carefully introduced under the skull, to prevent the pressure of the encephalon from raising the former plate. This last slip of lead must also have a thread fastened to it, for the more commodious extraction of it (*f*).

S E C T. CCXCIII.

THE remainder of the cure is afterwards compleated, as in wounds of the membranes (185 to 239.).

What has been said on the cure of wounds in general, will suffice to give a notion of what is necessary towards the compleating of the cure of an aperture trepanned in the skull; especially if we also attend to the considerations given in the comment on §. 245. A moderate temperature of the air is here extremely necessary while the wound is exposed, and the dressings should be seldom renewed; as well in the beginning, when the extravasated juices are discharged, as
in

in the latter end, when there is frequently a considerable suppuration. Applications too moist, oily, and relaxing, are almost constantly pernicious here; whereas olibanum, mastic, sarcocol, and the other gentle corroborating gums, ground into a fine powder, and sprinkled on the wound, are extremely serviceable. This method of treatment is confirmed by the authority of Hippocrates (a), who after having advised that all wounds in the head which are clean, ought to be treated with disiccative remedies, he subjoins, *Eadem quoque est ratio membranae cerebri ambientis: illa enim protinus esse secto & exempto nudata quam citissime purgari & siccare debet; ne, si diutius madescat, nimia uligine tabescat, & in tumorem exsurgat. His enim ita se habentibus periculum est, ne ipsa putrescat*: “ That the same method of treatment
 “ ought also to be used for the membrane investing
 “ the brain; which ought immediately to be cleansed
 “ and dried so soon as it is laid bare, by cutting out
 “ and removing the piece of bone; lest if it should
 “ continue too long soaking in the moisture, its firm
 “ texture should dissolve and rise up into a tumour.
 “ For under these circumstances, the brain itself may
 “ be in danger of corrupting.” A perfect rest both of body and mind, and a thin diet, ought more especially to be recommended: since the least error in the use of the fix non-naturals, may be extremely pernicious in wounds of the head; as appears attested and confirmed by many of the foregoing instances.

S E C T. CCXCIV.

AND thus will the margin of the bones in the aperture exfoliate within forty or fifty days time; and from thence forward a fleshy substance will arise and fill the cavity, which growing gradually harder, will at length become a bony

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(a) De capit. vulner. cap. 26, Charter, Tom. XII. pag. 126.

bony callus, having either a hollow or protuberant surface, and remaining afterwards weak and liable to pain.

All the circumference of the bone, cut by the teeth of the trepan, or abraded by the lenticular knife, was by them contused; and therefore it is that this whole surface of the bones becomes gangrenous, and ought to be separated before a regeneration of the lost substance can be procured. This has been very well remarked by Celsus (a), where he says, *Si quod etiam os adustum est, à parte sana recedit; subitque inter integram atque emortuam partem caruncula, quæ, quod abscessit, expellat. Eaque fere, quia testa tenuis & angusta est, πῆλις id est squama à Græcis nominatur*: “ That if the bone should
 “ be burnt by the heating of the trepan, in turning
 “ it swiftly round, that will separate from the rest of
 “ the sound bone; and a caruncula or fleshy substance
 “ will arise betwixt the sound and the diseased part of
 “ the bone, which will expel or cast off the latter.
 “ And the part cast off being like a thin and narrow
 “ shell, is therefore denominated by the Greeks πῆλις,
 “ a scale.” This separation happens sooner or later, according to the different age of the patient, and before it happens, the whole surface of the aperture begins to turn brown, and sometimes black: but all which is thus discoloured, separates by a mild suppuration, and then the living vessels begin to elongate from the whole circumference of the opening, and especially from the diploë and the dura mater itself, from whence these new formed vessels concurring and intermixing, renew the lost substance of the bone. This has been also well remarked by Celsus (b), when he says, *Ubi bene res cedit, incipit ab ipsa membrana; vel, si os eo loco duplex est, inde quoque caro excrescens id, quod inter ossa vacuum est, replet: nonnunquam etiam*
super

(a) Cels. Lib. VIII. cap. 3. in fine, pag. 513.

(b) Lib. VIII. cap. 4. circa finem, pag. 521.

super calvariam excrescit: “ When the wound is well conditioned, flesh begins to grow up from the dura mater, and also from the plate of the skull, when it is double, with which the vacuity of the bones is filled; and which sometimes grows up above the surface of the skull.” This growing substance does at first resemble a soft mucus: but by degrees changes into a callus, and at length acquires the hardness of a bone, after it has been of considerable long standing. If an equable pressure was always applied the cicatrix will be slightly, or uniform enough; but if the pressure was too small upon the luxuriant vessels, they will form a callus above the equal surface of the skull; but if the pressure was too strong, or if strong disiccatives were applied too early, the cicatrix will then be hollow. But generally the cure is compleated within forty or fifty days time, if no bad accident falls out to retard the consolidation.

It is well worth observing, that though the callus seems to be very perfectly formed, yet it frequently does not fill up the whole cavity in the bone with a substance that acquires a bony hardness; but generally a soft part remains in the middle, being of a more fleshy consistence, and may, perhaps, be a production of the dura mater united with the callus that comes from the whole circumference of the bone; and from hence the middle of the cicatrix is generally weaker than the rest, and probably never hardens into a compact bone. This is a circumstance which Garengéot (c) tells us he has observed in several skulls of dead bodies, who have had this operation performed, and especially in the skull of a man, who had been trepanned twenty years before by a celebrated Surgeon; for here he found an unequal aperture in the middle of the callus, large enough to transmit a small pea. No wonder then, if a weakness and pain frequently remain in this part of the skull, and especially a sense of pain upon a sudden change of weather; and hence it is

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also

(c) *Traité des opérations de Chirurgie*, Tom. III. pag. 214, 215.

also evident, that this part, though well, ought to be defended for a considerable time after the cure, lest it should receive some external injury. We mentioned upon another occasion, in the comment on §. 271, the extraordinary case of a girl thirteen years old, who having lost a considerable part of her skull, had the cicatrix broke open by a violent cough, nine months after the consolidation was compleated; insomuch that two ounces of the substance of the brain itself was forced through the wound in the cicatrix, of which accident she died five days after.

But Celsus (d) observes, that the cure succeeds well, *Si membrana mobilis ac sui coloris fuerit; caro incref-cens rubicunda; facilis motus maxillæ atque cervicis. Mala signa sunt, membrana immobilis, nigra, vel livida, vel aliter coloris corrupti, dementia, acris vomitus, nervorum vel resolutio, vel distentio, caro livida, maxillarum rigor, atque cervicis:* “ If the dura mater continues moveable and of its natural colour; if the
 “ growing flesh looks red, and the motions of the
 “ lower jaw and neck are easily performed. But they
 “ are bad signs when the dura mater is immoveable,
 “ black or livid, or appears of some other colour and
 “ corrupted, the patient stupid, intense vomitings,
 “ convulsions or palsies of the nerves, the flesh appearing livid, and the jaws and neck contracted.”
 And a little after he adds, *Capite fracto, donec jam valida cicatrix sit, vitentur sol, ventus, frequens balneum, major vini:* “ That after fractures of the skull,
 “ the sun’s heat, the wind, frequent bathing, and
 “ plentiful drinking of wine, ought to be avoided,
 “ ’till the cicatrix is become strong or compact.”

(d) Lib. VIII. cap. 4. pag. 520, 521.

S E C T. CCXCV.

THE inflammation, suppuration, gangrene, with the excrescent fungus of the meninges, but more especially of the cortical substance of the brain itself, are removed by the remedies proper for those disorders ; as also by the application of antiphlogistic, detergent, and antiseptic medicines, by ligature with a thread, and by using a leaden plate (292). To conclude, the malignity or fatality of wounds in the head may be judged of, 1. from their situation ; being worst in the occiput, sides, vertex, and futures : 2. from the symptoms ; as a fever with cold chills arising a week after the accident, tremblings ; a paleness, dryness, or livid colour of the wound ; a roughness or yellowness of the bone ; an hemiplegia or convulsions : 3. from the patient's age : 4. from his constitution or habit : 5. from the season of the year : 6. and lastly, from the malignant foulness or putrid state of the air.

It now remains for us to examine those symptoms which sometimes follow trepanning of the skull, and which often turn out of very bad consequence. For when part of the skull, which is quite full, is removed, then the contained encephalon and dura mater rise up through the aperture, unless prevented by the means directed in §. 292 ; and the dura mater being urged against the edge of the hard bone, the free course of the blood through its vessels is thereby impeded, whence inflammation and all its consequences may follow, especially a suppuration and gangrene. All this will be much excited likewise by the unusual contact of the parts with the external air, especially when it is cold.

cold. The like injury may also arise in the vessels of the pia mater, and in the cortical substance of the brain itself, whereby all the functions of the encephalon may be injured. When this malady is present, it may be removed by the general method of curing inflammations, which we shall describe hereafter; but it will be much safer to prevent it before arrived to any height. Plentiful bleeding, with the application of blisters to the legs or feet, emollient clysters, a thin diet, the plentiful drinking of whey or milk and water, &c. will dispose and arm the body against inflammation: and the same boldly repeated, will also remove an inflammation when formed, with all its urgent symptoms. For in this case every one must allow, that a suppuration or a gangrene will be of the most fatal consequence; and therefore these ways of terminating the inflammation ought to be prevented by all the assistances of art.

An evil pretty frequent, and much to be feared after a perforation in the skull, is a fungus, or dilatation of the cortical substance of the encephalon, which increases very suddenly; and which very seldom or never happens, so long as the dura mater continues entire: but this being either incised or eroded, the pia mater is so thin, that it cannot confine the dilating substance of the brain, which will still protuberate much more if the pia mater is also divided. This dilatation of the cortex is from its speedy formation and figure termed a fungus, as we observed in the comment on §. 268. Celsus seems to have remarked this symptom, but supposed it to be a tumour of the dura mater. For the skull being opened, and the dura mater uncovered, he says: *Quod si membrana per inflammationem intumuerit, infundenda erit. rosa tepida. Si usque eo tumebit, ut super ossa quoque emineat, coercebit eam bene trita lenticula, vel folia vitis contrita, & cum recenti vel butyra vel adipe anserino mista (e):* “ But if the dura mater should swell by an inflammation, you
“ ought

“ ought to pour in some rose-water warmed. But if
 “ it is so swelled as to arise above the bones, a well
 “ polished lenticular will confine it, or some vine
 “ leaves beat up and mixed with some fresh butter
 “ or goose grease.” But it seems evident from all
 observations, that this fungus arises from a distention
 of the cortical substance of the brain, deprived of its
 confining membranes, and bony covering, and thus
 dilated by the humours impelled by the force of the
 arteries; and this most considerably, when the veloci-
 ty of the circulation is increased by a fever. But since
 the cortex of the brain naturally contains no red blood,
 therefore upon cutting or eroding these fungi, they
 seldom discharge any blood; except the diameters of
 these small vessels have been so much dilated, as to
 admit the red parts of the blood, which seldom hap-
 pens, though observations witness it has been some-
 times thus seen. For in the wonderful case mentioned
 in the comment on §. 268, such a fungous excrescence
 arising after a perforation of the skull, had arteries
 strongly vibrating, and being roughly handled, bled
 very plentifully. From hence it is, that the impetus
 of the circulation being diminished, those fungi often
 subside a little before death, as we observed in the case
 mentioned, a few days before death: for a fungus equal
 to the size of a walnut, indolent, and of an ash colour,
 spontaneously disappeared a few days before the pa-
 tient's death; and a considerable cavity by that means
 appeared in the substance of the brain. Scultetus ob-
 served a long and broad fissure in the skull, with two
 fungi in a man wounded in the head by a scymitar:
 but upon inspecting the wound after death, he found
 the fungi very much subsided (*f*). All which is a con-
 firmation that the fungous excrescences of the cortical
 or vascular substance of the encephalon, arise from a
 dilatation made by the impulse of the humours.

It may be now asked, what is to be done in such a
 case, when a fungus of this kind protuberates? It
 cannot

cannot be pressed back, for that would compress the encephalon, and the fabric of this vascular pulp is destroyed even by a slight pressure; and thence would follow a suppuration, with the most malignant symptoms. And though it seems to be too dangerous either to amputate or erode the substance of the brain itself; yet there are innumerable observations which teach, that these fungi have been extirpated, not only without killing the patient, but even without injuring any of the functions of the encephalon. A fungus of this kind arose, through the perforation in the skull, after the use of the trepan, in a lad of fourteen years old; it was taken off by ligature, and then another of the like kind arose, which was removed in the same manner; and this being repeated several times, it appeared that a quantity equal to one's fist had been taken from the substance of the brain; yet the patient recovered after all this, notwithstanding the poor lad had his wound dressed, and looked after in a negligent manner by women, in the absence of the Surgeon (g). A lad of the same age received a considerable fracture of the skull by a heavy stone falling from a great height, upon the right side of his head. After the removal of a great many fragments of the bones, every thing seemed to be in a fair way but part of the dura mater, that was lacerated by the depressed fragments of the skull, being removed, after the twentieth day a fungus arose from the wound; which within four and twenty hours time grew above the skull, to the size of an hen's egg: but by the aspersions of an aromatic desiccative powder, and a plaster of the same nature, &c. the whole fungus subsided within the space of fourteen days, and the patient afterwards did perfectly well (h). There are many instances in the same author which teach that these fungi may be safely removed. But to treat these fungi with the more acrid sort of medicines, seems

(g) Hildani Observat. Chirurg. Centur. IV. Observ. 3. pag. 287.

(h) Ibid. Centur. I. Observ. 15. pag. 22, 23.

seems to be dangerous; for Hildanus relates in the same place, that an ignorant Surgeon, despising more prudent advice, sprinkled a powder of vitriol, and burnt alum upon such a fungus, from whence immediately followed most acute pain, violent fever, inflammation, delirium, and in a few days after death itself.

If we consider the wonderful apparatus of the anastomoses, by which the arteries of the brain communicate with each other, after they have entered the skull; and also observe, that injections teach us that the arteries of the pia mater do every where communicate with each other by anastomoses in the same manner; it will thence appear very probable by analogy, that the like mechanism must always obtain in the ultimate tomentous vascules of the cortex; and hence will appear the reason why the functions of the brain continue to be carried on entire, even though a large part of the cortical substance has been destroyed. It should also be observed, that even a small portion of the cortex of the brain, when not confined by its integuments, may be extended into an immense bulk, since it is composed of such small vessels, and so easily capable of dilatation.

It seems therefore to be the best method of removing these fungi, when large, by cutting them off close to the aperture of the skull by a thread, in which part they are always the smallest; but the smaller fungi may be taken down or contracted by the use of drying applications: and among these gum mastic or olibanum dissolved by boiling in spirit of wine, seem to be one of the most convenient and useful remedies; or the fine powder of mastic, or sarcocol, &c. may be sprinkled on the fungus.

But though the fungus is removed, it will quickly be formed again, if that equable pressure is not restored, which prevents the too luxuriant distention of its vessels, as we are assured by innumerable instances; and unless also the velocity and impetus of the circulation

lation be so moderated, as not to urge too much those minute vessels which are so easily dilated. The former of these is obtained by filling the cavity or aperture with scraped lint; or by the application of a leaden plate, as described under §. 292; and then by securing these in their stations by a proper bandage. The latter will be accomplished by lessening the quantity of distending juices by plentiful bleeding, by rest of body and mind; by antiphlogistic and diluent liquors drank plentifully; by a mild and spare diet; and the too great velocity of the circulation may be qualified by gentle anodynes. Clysters formed of the like materials, with the application of blisters or fomentations, &c. to the lower extremities, will drive the impetus of the juices downwards.

From the whole preceding history of wounds in the head, and also from what has been said on wounds in general, it is sufficiently apparent, that slight wounds of the head have often had a fatal end beyond all expectation; and on the other hand, that the most grievous injuries, not only of the skull, but also of the encephalon, have been sometimes cured without any injury of its functions. And this has been confirmed by a great number of observations, which we have before related from the best authors. From whence it seems to follow as an axiom, that no wound of the head, though apparently slight, ought to be negligently treated; and that one ought not hastily to despair in the most dangerous wounds of the head. But to form a prognosis in wounds of the head, agreeable to what is at this day known in the art of healing, we must attend to the following considerations.

1. In the occiput.] Because here are inserted the strongest muscles of the head; the cerebellum, on which life immediately depends, is here placed; and the large transverse sinuses are here lodged. If any blood is extravasated here from broken vessels, it will be extremely difficult to discharge it; and if the extravasated juices are lodged under the transverse processes

cesses of the dura mater, which covers the cerebellum, and defends it from the pressure of the incumbent brain, it seems in that case altogether impossible to discharge them.

In the vertex.] For in this place the skull is the longest time of all before it acquires its bony hardness; and in young subjects this place continues a long time membranous, and is then called the fontanel. The falciform process of the dura mater very firmly adheres to this part, and the longitudinal sinus lies underneath it; from whence the great danger of wounds inflicted in this part is very apparent.

In the sides.] Because the parietal bones are generally found very thin, especially in their middle; and the sulci or furrows imprinted in these bones denote that very considerable arteries of the dura mater are here placed. Besides, these bones of the skull are generally invested only with the common integuments; whence Hippocrates (*i*) concludes, wounds inflicted in these parts to be the more dangerous, because the bone is weak, the investing flesh thin, and the largest part of the brain lodged beneath.

In the futures.] Because in these the pericranium and dura mater seem to unite together, and here it is that the dura mater is more firmly attached to the skull; whence the injuries formed in the external parts may by this continuity of substance, be easily communicated to the internal parts. Add to this, where it is necessary to discharge the extravasated humours by perforating the skull with the trepan, the operation can never be made on the futures, and when blood is lodged betwixt the skull and the dura mater, it is always much to be doubted on which side of the future the cranium ought to be trepanned, especially as the dura mater by its firm adhesion or insertion into the futures, forms as it were so many distant chambers, in the manner we described in the comment on §. 285.

2. The symptoms arising after the infliction of the wound, teach us what functions are injured, and the more or less danger to be feared from the wound; and therefore the more numerous and malignant the symptoms, the case is always the more dangerous. But it was said before in the commentary on §. 240. numb. 4, that the worst symptoms appearing soon after the infliction of the wound, are often less threatening than those which appear some days afterwards; and this we confirmed by the testimony of Hippocrates. A fever arising seven days after the infliction of the wound, has always been esteemed of very bad import; for it almost constantly denotes a new inflammation or suppuration, which are here so much to be feared; and Hippocrates (*h*) himself condemns this fever as a sign that the skull is injured, or its cure neglected. But the changing of the red colour of the wound into a pale or livid, or, as it sometimes happens, into a colour like flesh that is stale, or has been long salted, the lips of the wound also appearing dry; all these denote a tendency of the parts to mortify and corrupt, as we explained more at large in the comment on §. 255. numb. 8. But since the skull is naturally smooth, and of a pale red or bluish colour; an apparent roughness, or a change of its colour into yellow or brown, denote a corruption of it, and that the part thus altered ought to be separated either naturally or by art: but on this you may consult what has been said in the comment on §. 249. But a hemiplegia, as also convulsions, denote that the brain itself is affected; whether it be by compressure from an indentation of the skull as considered in §. 267; or from humours extravasated under the skull, compressing or corroding the brain; or else barely a violent concussion of the brain, without any considerable extravasation of the juices, so as to destroy or much alter the tender fabrick of the encephalon, concerning which you may consult §. 273, 274, 275.

3. In

(*h*) De capit. vulner, cap. 31. Charter. Tom. XII. pag. 127.

3. In younger subjects the bones being softer, give way more easily, and resist less the action of wounding causes; but in adults the bones are all quite firm; and indeed in old people all the bones are very hard, but then they are extremely brittle. Add to this, that all the bones are in the younger age more vascular, and therefore more plentifully supplied with juices; when as age advances, a great many of the small vessels concrete into solid fibres, as Hippocrates (1) beautifully observes, where he says, *Puerorum vero ossa & tenuiora sunt, & molliora ideo, quod sanguine magis redundant, &c: unde ab eodem, vel & leviori vulnere, junioris pueri os magis & citius, minorique temporis spatio purulentum evadit, quam senioris. Et si alioqui ex vulnere moriendum sit, junior seniore citius perit:* “ But the bones of children are also thinner
 “ and softer, because they abound more with blood,
 “ &c. whence it is that a bone in a young child
 “ more easily and speedily corrupts into a putrid state,
 “ even from the same or a slighter wounding cause,
 “ than in those who are older. And a young patient
 “ dies sooner of a mortal wound, than one who is
 “ older.” Add to this, that the younger subjects have their nervous system more sensible of irritation, whence it is that they are so easily convulsed, even from slight causes; and therefore wounds of the head are on this account more dangerous in the more tender age. But then in old people we constantly observe, that the bone is longer in exfoliating, and the regeneration of the lost substance is more difficultly procured; because the living vessels are less numerous in the bone in old age; insomuch, that frequently the whole diploë, which is almost entirely vascular in young subjects, entirely disappears in old skulls.

4. The temperament of the wounded patient may be considered in two lights, either as morbid or healthy. For every individual man has one particular healthy crasis, which can only be termed healthy in

his own particular person: and we see that people enjoy a state of health under very different states both of the solids and fluids. This state then is termed the health of the temperature; which the antient Physicians distinguished into hot and cold, moist and dry. It is apparently true, that a variety of symptoms arise from this distinction in all wounds, but more especially in those of the head; for in hot and bilious men the inflammation is much more intense, and the extravasated juices degenerate into a state much more acrid: whereas the contrary of all this takes place in cold, phlegmatic, and weak men. But the morbid temperament may be known from the predominant cacochymy or indisposition of the fluids: and the worst of these indispositions in wounds of the head is that which frequently infects and corrupts the bones, as in the rickets, scorbutic, and venereal disorders, &c.

5. Extreme hot air and freezing cold are always highly pernicious in wounds of the head; but the temperature of the spring is most serviceable. But Hippocrates condemns the summer heats as more pernicious than the winter cold, where he says (*m*), *Et hyeme diutius vivet homo quam æstate, si quis cæteroquin periturus sit ex vulnere, quacumque demum capitis parte vulnus habeat*: “ That a man will survive longer, “ after having received a fatal wound, in the winter “ than in the summer, in whatever part of the head “ the wound be seated.” And in another place, after enumerating the signs by which one may know whether the person will die of the wounds in his head, he says, (*n*) *Æstate ante septimum diem, hyeme ante decimum quartum pereunt*: “ That in the summer time they “ expire before the seventh day, but in the winter before the fourteenth day.” It is also more easy to moderate the cold of the winter’s air by fire, than to cool the intense heat of the summer’s air. And perhaps this may be one reason why wounds in the head have

(*m*) De Capitis vulner. cap. 4. Char. Tom. II. pag. 117.

(*n*) Ibid. cap. 21. pag. 128.

have been observed so very difficult to cure in hot countries; for thus it is in Italy, according to the testimony of Duretus. But another reason was also given for this in the comment on §. 245.

6. It was said before in the comment on §. 245. that a free access of the air, especially when cold, is always prejudicial to wounds in the head: and in the comment on §. 200, it was demonstrated, that a pure air, frequently renewed and freed from all putrid exhalations, is extremely beneficial to all wounds. Whence it is, that after a battle, which usually happens in the summer time, when a great number of the wounded are crowded together in an hospital, the air is so filled with putrid exhalations, that a great number of them perish, especially those who are wounded in the head. Hence the skilful Surgeon Belloste reckons it one of the principal advantages of his speedy method of cure, by perforating the bone with many small foramina, described in §. 252, 253, 262; that the patient growing well sooner, does not lie languishing in an hospital, where the strongest constitutions are often dangerously affected by the putrid exhalations, as we daily experience: and whence he affirms, he has a hundred times seen them taken and carried off by a putrid fever, hæmorrhage, diarrhœa, &c. when they were almost well and about to be discharged (o).

S E C T. CCXCVI.

IF any blood, matter, or sordes appear under the dura mater, after perforating the skull; the confining membrane ought in that case to be boldly punctured or incised to discharge them.

Trepanning the skull will indeed give a passage for the discharge of humours extravasated betwixt the

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dura mater and the skull; but when those humours are lodged under the dura mater, it is then very apparent they cannot be discharged without perforating that membrane also. It is indeed true, that all Surgeons and Physicians industriously endeavour to avoid injuring the dura mater by the teeth of the trepan in perforating the bone; since that would be in danger of producing inflammation and hazarding the patient's life, as Celsus (*p*) testifies: but it is one thing to lacerate this membrane by the rough teeth of a saw, and another to cut through it with the thin and smooth edge of a lancet. Nor is there any other method but that of incision left in this case; for if the extravasated juices continue there, they will corrupt and destroy the tender fabric of the encephalon, or erode and eat through the dura mater by a gangrene, as (*q*) Scultetus tells us in a case he relates: But this method appears to be safe enough also from practice and observations; for a large part of the dura mater was cut off in a dangerous wound of the head, penetrating deeply into the substance of the brain, and yet the patient was cured. This is evident from the case we mentioned in the comment on §. 187, where a large portion of the skull was cut out by twice applying the trepan, and the dura mater was also cut away, from the whole extent of the large aperture. But when extravasated blood is con-creted under the dura mater, it often appears of a black colour through the pellucid membrane; and if the Surgeon goes to extract the grumous blood with his piers, he takes hold of the dura mater. If he is not certain whether the blood lies without or under the dura mater, let him gently touch the place with his finger moistened with saliva; and then his finger will be tinged with the blood if it lies externally, but not coloured at all if it is under the dura mater. But when the dura mater is incised, it is evident from what

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(*p*) Lib. VIII. cap. 3. pag. 512.

(*q*) Armament. Chirurg. Observ. 2. pag. 195.

we said before, that there will be danger of a fungus of the brain forming itself; which must therefore be prevented by a suitable pressure. But when the extravasated juices are not lodged betwixt the dura and pia mater, but in a deeper part of the brain, as in the ventricles themselves, the case is then incurable. For who dare cut through the fabric of the brain itself? The only hope that remains, is, that the pressure of the encephalon exactly filling the skull, will force and drive the extravasated humours from the other parts where it is lodged, towards the aperture of the skull and dura mater.

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